BULLETIN NO. 28.

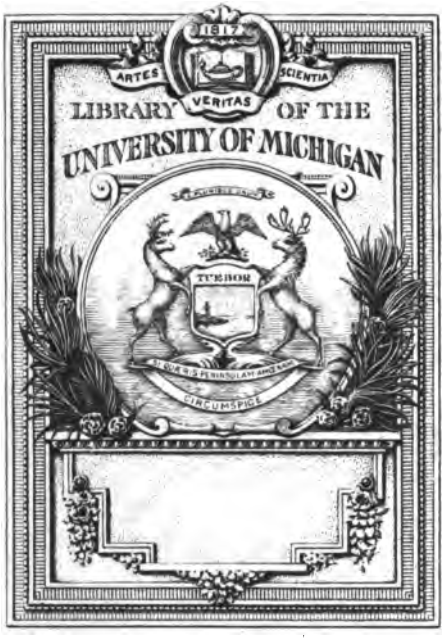
THE REAPER

VIRGINIA DEPARTMENT OF AGRICULTURE

ANNUAL REPORT 1905

GEO. W. KOINER, COMMISSIONER.

CHAS. E. FOOT PRINT RICHMOND



Department of Agriculture

OF THE

STATE OF VIRGINIA.

Annual Report for the Year 1905,

BY

G. W. KOINER, COMMISSIONER.

RICHMOND:
DAVIS BOTTOM, SUPERINTENDENT OF PUBLIC PRINTING
1905.

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OF

Agriculture of the State of Virginia.

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FIRST ASSISTANT CHEMIST.....C. M. BRADBURY.
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REPORT

OF THE

President of the State Board of Agriculture and Immigration.

His Excellency, A. J. MONTAGUE,
Governor of Virginia.

SIR,—As President of the Board of Agriculture and Immigration, it gives me great pleasure to state that the work of the Department of Agriculture is making rapid progress. The members of the Board have a sincere desire to do everything in their power to advance the agricultural interests of the State. The attendance at the meetings have been full, and the deliberations of the body harmonious. The work as outlined in the statement of my predecessor last year in the geological work and farmers' institutes in connection with the Virginia Polytechnic Institute, has progressed satisfactorily.

The fertilizer law has been vigorously executed by our very efficient Commissioner, and is giving valuable protection to the farmer from fraud and loss in the fertilizers he buys.

The farmers' institutes held have been numerous and well attended by the people, and this work will be continued as before. This Board is made by the Constitution a Department of Immigration also, but the Legislature has never made any appropriation for immigration work. The Board has appointed a committee to ask for an appropriation by the Legislature to be used in advertising the resources of the State in other States and in some of the foreign countries to induce people to buy our idle lands, also to bring labor here to work upon the farms. Your able assistance is respectfully requested in this most important matter.

The experiments that have been made and are in contemplation at the Test Farm will increase the value of the farm to the farmers in the State. Improvements on worn out land are necessarily slow and requires

time to give satisfactory results. Your attention is respectfully called to the report of the Manager of the Test Farm, giving a detailed statement of the experiments that have been made there during the past year.

The agricultural conditions over the State are improving; our farmers are growing better crops and doing better work, and a spirit of thrift and advancement is apparent. For a detailed statement of the receipts and disbursements of the work of the Department, you are respectfully referred to the report of the Commissioner.

The accounts of the commissioner are carefully examined quarterly by the Board.

Respectfully submitted,

C. W. HEATER,

President of State Board of Agriculture and Immigration.

REPORT

OF THE

Commissioner of Agriculture.

Honorable A. J. MONTAGUE,
Governor of Virginia.

SIR,—I herewith submit the twenty-seventh annual report of the work of the Department of Agriculture. It is apparent to every observer that the agricultural conditions in Virginia are moving forward year by year. The past year has been one of the most prosperous; our lands are increasing in value; in some sections the increase has been fifty per cent. and more in a few years. The farmers are improving their system in farming by studying and applying modern methods in agriculture, and are growing larger crops, and are keeping more live stock.

In horticulture the advance is very gratifying, in very many instances the sale of the apple crop amounted to three or four times more than the entire income from the other crops. Virginia is becoming a great fruit State. Our farmers write that the bulletins, reports and farmers' institutes have given them much valuable information. One hundred and sixty-five thousand of these publications have been sent out during the past year. New farmers' bulletins have been issued by the Department this year, on raising sheep in Virginia, Virginia as a horse and mule State, fruit growing in Virginia, corn growing in Virginia, poultry raising for profit, cattle raising in Virginia and lead and zinc deposits in Virginia. A large number of a bulletin giving "Information to the Home-seeker and Investor" has been distributed outside the State during the past year.

The fertilizer inspection and analysis gives the farmer the true contents of the fertilizer he uses and the commercial value per ton, so that he may not be overcharged for what he buys. This fertilizer law in its operation has saved the farmers of this State at least half a million dollars every year since its enactment. For without this protection the farmer is at the mercy of the manufacturer. There is nothing easier than to defraud in fertilizer if the manufacturer desires to do so.

A new hand-book is in press giving the resources of the State in the various lines for agricultural and industrial development, which will be sent out beyond the borders of this State.

Immigration into the State has increased more within the past year than in any previous year. About twenty-five hundred farms were bought last year by people from outside the State, which brought into the State at least eight million dollars. The splendid business exhibit made by the State at

the World's Fair is now yielding good results. The appropriation made by the Legislature for that purpose has proven to have been a wise one. There are 10,000,000 idle acres of land in this State; we need more people and more money to develop them. The Board of Agriculture and Immigration is most desirous that the Legislature make a liberal appropriation to be used in bringing in desirable homeseekers and farm labor into the State. In every county in the Commonwealth there is a strong demand for labor.

A large number of farmers' institutes have been held, with gratifying results, and this good work will be continued.

A pure food bulletin (No. 23) has been issued this year, giving the analysis of many brands of foods and feeds. The appropriation of $2,000 by the Legislature is inadequate for this work. Some States appropriate $20,000 for this work.

A large number of minerals have been examined, also samples of mineral waters and waters for purity, all free of cost to our people.

The work of the Department is widening and increasing each year, which necessarily increases the expenses of the Department, but the scope and extent of the work done by this Department is greater and at less expense than by any other State. During the past year nearly eighteen thousand letters have been written, and daily the Department is visited either by our own people and by homeseekers and investors seeking information. The employees have been faithful and efficient in the discharge of their duties.

A financial statement and report of the Chief Chemist is embodied in this annual report.

All of which is respectfully submitted,

G. W. KOINER,
Commissioner.

FINANCIAL STATEMENT.

Disbursements and receipts for fiscal year, ending September 30, 1905.

EXPENDITURES.

Expense of Board	$1,307.08
Expense of Fertilizer Inspection	6,530.85
Express, telegrams and drayage	252.87
Farmers' Institutes	3,347.16
Fertilizer Tags	1,062.00
Geological Survey	4,850.00
Incidentals	95.00
Laboratory	1,479.73
Museum	253.95
Office Expenses	405.54
Printing	6,691.95
Printing Special Publications	220.13
Premium on Bond	75.00
Salaries	8,383.29
Special Assays	14.00
Stationery and postage	1,465.12
State Horticultural Society	500.00
Test Farm	4,343.10
Travelling expenses	165.65
Total	$41,442.42

RECEIPTS.

Balance October 1, 1904	$11,582.53
Tonnage tax from October 1st to September 30th	41,892.36
Total	$53,474.89
Expenditures	41,442.42
Balance October 1, 1905	$12,032.47

Division of Chemistry.

REPORT OF THE CHIEF CHEMIST.

Hon. G. W. KOINER,
Commissioner of Agriculture and Immigration.

SIR,—Since making my last report to you everything in this division has progressed smoothly, although it has been very much crowded with work, more so than ever before. On June 1st, Mr. H. H. Hurt, the First Assistant Chemist, resigned to accept a position with the Bureau of Chemistry of the United States Department of Agriculture. Dr. C. M. Bradbury, the Second Assistant, was made First Assistant, and Mr. J. B. Robb, of Caroline county, was appointed Second Assistant. Mr. Robb has the degree of Bachelor of Science of the Agricultural College, Maryland, and the degree of Master of Science of Columbian University, and he was First Assistant to the State Chemist of Maryland.

For two months during the summer Mr. P. L. Conquest, Jr., who had taken a two-year course in chemistry at the University of Virginia, worked in the laboratory simply for the practical experience to be gained. He rendered valuable assistance, and aided materially in finishing up the large amount of work on hand at that time.

WORK OF THE YEAR.

The following is a summary of the work done in the laboratory from January 1st to November 10th, the date of this writing:

Fertilizer samples analyzed	1,144
Food samples analyzed	144
Mineral and miscellaneous samples analyzed or examined	277
Total	1,565

These are classified as follows:

Fertilizers collected by inspectors	1,067
Fertilizers sent in by farmers	77

FOODS—

Stock feeds	20
Baking powders	12
Canned Goods—	
Beans, Lima	4
Beans, baked	6
Peas	17
Snaps	9
Peaches	20
Pears	10
Apples	2
Coffee	11
Pepper	28
Mustard	8
Tea	8

MINERALS—

Ashes	9
Clay	24
Copper	9
Feldspar	6
Granite and Gneiss	8
Gold	6
Iron	25
Kaolin	6
Limestone and Marl	48
Manganese	6
Mica	16
Pyrites, Iron	21
Quartz and Sand	31
Sandstone	5
Slate	9
Water	9
Zinc	4
Miscellaneous	26

FERTILIZERS.

There were 1,772 brands of fertilizers registered during the year, an increase of 138 over last year, thus showing that my hope expressed last year that the fertilizer manufacturer had about reached the limit in their desire for bestowing new names on fertilizers has not been fulfilled. I hope that this year the fertilizer manufacturers and farmers will co-operate so as to

reduce the number of names instead of increasing them. All the name a fertilizer needs is its composition, and if the farmers would buy by the composition and pay no attention to the name, they would be much better off.

QUALITY OF THE FERTILIZERS.

The following table gives a comparison of the fertilizers for the past five years:

FERTILIZERS FALLING BELOW GUARANTEE.	YEARS.				
	1901.	1902.	1903.	1904.	1905.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Below guarantee	20.66	11.55	10.70	19.10	13.49
10 per cent. below guarantee	1.69	.84	1.99	1.91	2.09
Below guarantee in phosphoric acid	24.61	4.21	6.55	8.96	9.76
10 per cent. below guarantee in phosphoric acid		.38	1.24	1.51	2.86
Below guarantee in ammonia	40.42	42.81	31.03	51.00	35.54
10 per cent. below guarantee in ammonia		25.18	9.83	26.75	14.59
Below guarantee in potash	24.34	31.65	29.57	35.82	25.50
10 per cent. below guarantee in potash		17.87	13.42	19.18	4.39

From the examination of the foregoing table it can be seen that the quality of the fertilizers has improved very markedly over last year. The number falling below guarantee is much below last year, although the number falling 10 per cent. below has slightly increased. The phosphoric acid does not show up quite so well, but the ammonia and potash have improved very greatly, the potash having less than a fourth as many samples falling 10 per cent. below guarantee than last year. There, however, is still room for improvement, and it is hoped that the fertilizer manufacturers will improve next year as much as they did this.

DISSEMINATION OF RESULTS OF ANALYSIS.

Four fertilizer bulletins and one food bulletin have been published under your direction during the year giving the results of the analytical work.

PURE FOODS.

The first food bulletin (Bulletin No. 23) was published last April, and it contains the food law, the standards of purity for food products adopted by the United States Department of Agriculture, the rulings of the Department of Agriculture of this State in regard to how foods must be labeled, together with the results of the analyses of 214 food samples.

The following table gives the kind and number of foods examined and the number of each kind, either falling below standard, adulterated or containing an injurious metal.

NAME OF ARTICLES EXAMINED.	Number of Samples Examined.	Number of samples found, either below standard, adulterated, or containing an injurious metal.
Baking Powders	12	2
Canned Beans, Lima	4	4
" " Baked	6	6
" Corn	24	22
" Peas	17	17
" Snaps	9	9
" Tomatoes	29	29
Coffee	11	0
Flour	23	0
Meal	12	0
Molasses and Sirups	18	9
Stock Feeds	34	3
Tea	8	0
Vinegar	7	3
Total	214	104

From this table it is readily seen that the foods make a bad showing, as 48.6 per cent. of them are not as they should be, which shows very plainly the need of a food law, and the examination and analysis of foods. With the present small appropriation for food work the foods cannot be looked after as they should be.

Of the foods examined baked beans probably showed up worse than any other, for out of six samples examined, three contained a dye stuff, two a preservative, one both a dye and a preservative, and one which claimed to have a sauce had none, but did have a dye.

LABELING.

Many foods offend, or, to say the least, produce a wrong impression by the way in which they are labeled. Frequently the label either states that the goods are what they are not, contain ingredients which are not present, are made from materials which have never been near them, or does not state all the ingredients which are contained in the goods, and these ingredients which are not mentioned are most frequently undesirable. The Department of Agriculture has adopted the following rule: "All foods offered for sale in Virginia must be so branded or labeled as to truly set forth the contents of the material so branded or labeled." Brand all foods honestly, and honestly maintain them up to the standard as branded. In the future all manufacturers will be required to live up to the above rule.

MINERALS AND MINERAL WATERS.

The number of minerals and miscellaneous samples examined up to date is largely in excess of the number examined the whole of last year, and

the number sent in steadily increases as it becomes more generally known that this Department does such work.

On account of the press of other work, the analysis of water has had to be stopped since the early part of the year, and all requests declined. If all the water had been analyzed for which requests have been made, it would have taken nearly the entire time of one chemist.

This State is noted for the value and variety of its mineral waters, and it is important that more of her springs be analyzed in order to maintain the prestige she has acquired. To do this work, the portion of the time of an additional chemist would be required. In connection with the analysis of water, I would recommend that a charge of five dollars be made for each mineral water analyzed, in order to prevent people from sending in samples from idle curiosity.

ANOTHER ASSISTANT.

I recommend that another assistant chemist be employed for the following reasons:

(1) Because the fertilizer work has increased, and is still increasing, there having been more samples analyzed than ever before, and because it is desirable to analyze still more, and also to make the analyses more promptly.

(2) Because the mineral and miscellaneous samples sent in for examination are constantly increasing.

(3) Because there is a great demand for water analysis, which work has been discontinued entirely, owing to lack of time.

(4) Because the soils of the State should be analyzed in conjunction with the soil survey, which the United States Department of Agriculture is making.

Respectfully submitted,

E. W. MAGRUDER,
Chief Chemist.

Information that will Aid and Encourage Farmers in their Daily Business.

EDUCATION OF THE FARMER BOYS.

Education and Agriculture. What connection is there between the two? What have they to do with each other? If the average person were asked this question, he would quite certainly be at loss for a ready answer. Indeed, not every man of decided intelligence could readily formulate a clear statement of the advantages which an educated agriculturist would possess over an ignorant one in the prosecution of his ordinary duties upon the farm. It is very probable that many would declare that an educated farmer would be less apt to succeed than one who is unacquainted with books, and a stranger to high schools and colleges. "Your book-farmer" is an epithet of derision, as implying a visionary dreamer who has delved in books for instruction in husbandry, to the neglect of experience and practical methods. So that there is among the rural population a prejudice, more or less general, against collegiate education as being an impediment to the successful cultivation of the soil.

A well-to-do farmer who has several sons will send to college those whom he desires to equip for the learned professions (law, medicine, the ministry), while the public school of the neighborhood affords, in his estimation, a sufficient instruction for those who are destined to a life on the farm. The reasoning that leads to this view is based upon a fundamental error, namely, the idea that the cultivation of the land, and the management of the farm, does not require education and mental training. A different view has of recent years begun to take possession of the public mind, and is day by day becoming more generally and more distinctly recognized. It is rapidly becoming an accepted fact that in every department of human industry (the farm, the factory, the foundry, the mining camp), the higher education, the culture of the college, the training of the mental faculties anywhere and in every way, tells as effectually as it does in the pursuit of the learned professions. In the case of the agriculturist this is illustrated in the more remunerative results of husbandry that attend the employment of modern and improved methods as contrasted with the old, accustomed, routine of tillage and crop-raising. Why should this not be so? In what department of human industry are there more novel problems, more new theories,

more restless speculations, more recent and varied fields for experimental science and exploration than in the department of agriculture, or husbandry? The pursuit of husbandry under the new methods is no more akin to that occupation under the old-time regime than is the science of astronomy since the invention of the telescope, akin to the blind astrology of the ancient world. There is a science of agriculture as real and distinct as there is a science of mathematics or astronomy or engineering or navigation. The civil engineer and the navigator may as well undertake to make a successful survey or a successful voyage without the guidance of his compass as can the farmer expect the best results from his labor without resort to the improved appliances and modern methods introduced by scientific treatment of the soil and the crops, methods with which we are made acquainted by the agricultural colleges, the experiment stations, and the schools for special instruction in the art of agriculture. The time has come when educated men are to be the leaders in all the departments of husbandry, just as they are the leaders in every other department of human industry and endeavor. Just here we may pause to enter a protest against a growing disposition in recent years to limit the education requisite for successful farming to special instruction in the "principles of agriculture," and the art of husbandry. Polytechnic Institutes where these are taught are assuredly of incalculable benefit, are, indeed, indispensable. But it should be distinctly kept in mind that such instruction can never supersede the advantages of a full, rounded education, in which all the faculties of the mind shall be trained by study of the mathematics, the sciences, the languages and the philosophies. It is only the mind that is thoroughly trained, and the faculties that are thoroughly sharpened, by the discipline of the high school and the college, that can, with complete satisfaction, appreciate and apply the ripe results of scientific investigations and experimental studies in the various topics and details that constitute the work and business of the farmer. The man, or youth, who has a thorough scientific and scholastic training will be far readier and apter in availing himself of the practical results of special investigations in the various departments of agriculture.

There is another advantage arising from a collegiate education. The farmer whose faculties are thus disciplined, and whose mind is stored with information, will acquire a fondness for books, and will gradually accumulate a library that shall contain not only the books that appertain to the art of husbandry, but the standard volumes of our English literature; volumes of history, of biography, of travel, of fiction, of poetry, and the general domain of literature. Such a library will, to a mind so trained and equipped, be a perennial source of entertainment. It will be his resort for profitable reading and entertainment during the hours that are not required for outdoor supervision and management of the farm. Thus his home will be attractive to him, and he will not deem that he must periodically visit the city for relaxation and pleasure. A prime object ought to be to make the farm life attractive. The rural free delivery system has added greatly to the comfort and the pleasure of the country home. The newspaper and the magazine is delivered daily at your very door. This puts the most distant farmer in daily contact with the great busy and moving world without; and with the addition of the now cheaply-acquired telephone he may hold hourly

converse with his neighbors, and even with his city acquaintances, and with the merchants to whom he sends his produce and from whom he gets his family supplies. Add to this that he may receive the agricultural bulletins, and the government publications upon agriculture, and he enjoys at his country home almost all the rational gratifications and advantages which a residence in the city can afford. It will be even truer in the future than it has been in the past that the more intelligent of our citizens will regard the country life as preferable to that of the city, both for himself and his children, not only for the salubrity of the invigorating air, and exhilaration of its out-door exercises, but for the delights of its fireside enjoyments, and the intellectual recreation of its well-stored library. The Roman epicure buried the oyster in the snows of the Apennines that he might unite in the pleasure of the palate the product of the seaside with that of the mountain top. The modern conveniences have combined in the farmer's home the attractions of the city with the simple and healthful employments and pleasures of the country.

While, therefore, a full collegiate education is of incalculable advantage, if it is not practicable to secure this, the boy who is destined for the farm ought, by all means, to receive a course of instruction in the schools that teach the principles of agriculture, especially those that have the adjunct of the experimental station. The number of those who, in our Southern section, receive such instruction is distressingly small. According to the census returns, only one person in 10,000 receives any schooling in agriculture. And yet $40,000,000 is annually spent for schools and colleges in the South; so that the amazing spectacle is presented of an agricultural community that expends this enormous sum for educational purposes, and yet gives instruction in agriculture to only one in ten thousand of the agricultural population. There is a growing demand for the introduction in our public schools of a course of instruction upon the Principles of Agriculture; and the State Board of Public Education has placed an elementary work upon this subject upon the list of books to be used. This is an important step in the right direction, and *should be used in every school in the State.*

Much is written in the public prints about the industrial progress of the South. In some of the activities, in most of them indeed, such as railroads, factories, foundries, and almost every department of mechanical industry, this progress has been simply fabulous. Its story reads like a chapter from the Arabian Knights. But in this proud picture of industrial progress the agriculturist, the farmer, can claim but small participation. The improvement and progress in the husbandry of the South, while apparent indeed, has not been commensurate with her prodigious advance along the other lines of industry. This is largely due to the fact, almost solely due to the fact, mentioned above, that only one in ten thousand of her population receives instruction in the science of agriculture. It is due to the fact that our farmers do not appreciate the importance of education, the importance of giving their sons, who are to make their livelihood out of the cultivation of the soil, an education in the modern arts, the modern methods, of husbandry. Until our agriculturists understand and appreciate this,

and make a practical demonstration of it by giving to their sons who are to be farmers, the same educational advantages they give their sons who are destined to the professions; and especially until they give them the benefit of schooling in the principles and science of agriculture. Let the farmers insist that primary agriculture shall be taught in every public school. Let the Summer Normals instruct the teachers, let the Normal College instruct their pupils who are to become teachers in the public schools; let a start be made, and improvements in the methods will come in the near future. Give the farmer boys a start.

A Plea for the Farmer's Boy.

By Dr. J. B. WEEMS, *President of the Indian Oak Farmers' Club, Crewe, Nottoway County, Virginia.*

The farmer's boy who has a heritage of being born in the country and he who grows up amid the surroundings of the farm is blessed in many ways. It is not an easy task, however, to prove to a large number of them that such a blessing is of any value for the reason that the majority of people have been taught, and yet think, that most of the work of the farm is drudgery. If drudgery of any kind is undertaken in an intelligent manner it ceases to be mere drudgery, and such, when overcome as the result of skillful efforts and with the aid of machinery, lays the foundation for the future master workman.

There is no broader field for any young man, where he can build for himself, where the work of his hands can be made to return results in the future, where the mental efforts that are thought out in connection with nature's processes will return an hundredfold harvest, than on the farm. There is no field that offers better advantages to the person who desires to make a specialty of any certain branch of farm work or to the general worker who may desire a general field for his operations and not be restricted to a limited one.

At the present time where every person is advised and in most cases compelled to become a specialist within a very restricted field for thought and action, the farm is probably the only place where one can have the advantage of being unrestricted.

The nature of the boy that is nurtured in surroundings where every one is a specialist is a problem of the future. Will a boy, the product of such conditions, grow into a normal man, capable of meeting the demands of life, or will be a product dependent on others for a large share of his food, clothes and even the thoughts that he thinks? Will the future bring to us a class of beings born into the world and at birth destined for a trade or profession with the possibility of choice as to the future of their work limited more and more? Will not the man whose boyhood has been spent close to nature, who has a well developed, natural body, not developed by abnormal conditions for athletic training, but meeting the demands of

Mother Nature day by day and who has grown in an atmosphere characteristic for independent thought and action, be the one most capable of meeting the demands of true manhood and true citizenship?

Such questions are startling when they come to us with their full meaning. Shall we wait for nature to answer them?

Mother Nature in her School of Nations seldom answers such questions for centuries, but when she does, the penalty is the nation's doom. The lack of foresight to solve these problems is not excused.

The value of the farmer's boy to the world cannot be readily estimated. The greater the opportunities that he has the greater value he will be to the country.

The State must learn that his education is not an expense to be dreaded by the tax payer, but that it is the greatest opportunity that she has for making an investment, the interest upon which her most gifted son has not the mental capacity to calculate the value.

In the past our youth have been taught that to die for one's country was the greatest heroic deed, but the future education will also teach that to live for one's country, a true life, has equal, if not greater, glory.

These truths must be taken to heart by all those who are interested in the welfare of the State.

The farmer, interested in the future welfare of his children, naturally wants them to have the advantages of an education. His children are his treasure, and he has invested in them the efforts of the best years of his life. He has great faith in the public schools, and his children attend at every opportunity. There are many serious problems connected with rural education. Generally the studies of the country school are not what they should be for the mental development of the pupils. The teachers are trained with the requirements of the city school, in view for their future occupation, and many of the most capable, naturally seek the positions in the schools of the city. It is doubtful whether those in authority in the government of our schools, realize fully the value of the true teacher during the early years in the education of the child. There is a vast difference between dynamical teaching and mechanical instruction in education.

The farmer, unfortunately, depends too largely on the efforts of others for the education of his children. The great need of the times especially, is that the farmers take a more active interest in the rural schools. School directors should be selected for their capacity for business and interest in education, and not simply because they have a desire for holding the office.

Some interest in the selection of the school superintendent of the county will surely give good results. Let him realize that he is expected to introduce business methods into the education of the children, and that an egotistical, and negligent, or perhaps an incompetent, board of directors will not be tolerated in spite of their excuses and pleas that they are doing all in their power for the schools. Make the suggestion that the days of the one horse power school boards are past, and see that your board has the capacity for more power.

It is an excellent idea to discuss the question of education in the farmers' clubs at every opportunity. The interest in the schools will increase

as the subject is discussed, and before many months have passed the entire community will be alive to the best interests of the schools.

While the education of the farmer's boy is being considered from the view of the public school, do not forget that he has a large part of his time which is not devoted to his studies and it is a part of the boy's education to see that his time is used wisely. A good school library is an excellent aid to get the boys into a reading habit. Let the books be selected with care, and wherever possible, give preference to those books that dignify the work of the farm. Too many of the modern story books tell the story of the farm boy who made a success by leaving the farm, and many a reader who had faith in the story has followed the suggestion to his sorrow and loss. How many tramps have been made as the result of the reading of the modern story book of adventure, in all probability, will never be determined.

The introduction of agricultural studies in the schools will give great aid in dignifying the work of the farm in the eyes of the pupils. These studies, in connection with good books on farm life and nature studies will render great help in solving the problem of keeping the boys on the farm.

It must not be thought that the education of the farmer's boy is a problem for the school only. The education in the home is of greater importance than that of the school. It is said that the first six years of childhood can be made as important in education as the college or the university. The boy's room, with a few books for his own, pleasant surroundings for his leisure time, and a few pictures on the walls, will perform wonders.

The American boy is naturally a mechanic and he is throughly interested in engineering. If one looks over the catalogues of the agricultural colleges it will be noticed that most of the engineering students are from the farm. The reason for this condition, is that the study of the various branches of engineering have been made attractive to these boys, while in contrast with this attractive side the science of the farm has been given the gloomy view.

This condition must be changed and the possibilities of the farm presented in their true light. Think for a moment, do you know of any engineering problem that will require the knowledge connected with it, that is demanded by the thorough understanding of the engineering processes that take place in the corn field or which require, as a great combination of art and science for a successful outcome in the harvest?

Do you know of any field where there is an opportunity for the application for a combination of science and engineering than in the study of the animal life on the farm?

The transformation of the farmer's boy into the future citizen of the State will require the best efforts of her people. The State will have the problems to solve in his education. The State and local fairs can give great aid by making the production of good citizens, at least equal to horse racing and the breeding of high grade farm animals. It is a regretable fact that too many of our Commonwealths advertise their ability to raise good farm animals and say nothing of their efforts in behalf of the greatest product of the farm, The Farmer's Boy.

The Improvement of Land.

Address delivered before the Association of Commissioners of Agriculture of the South in Richmond by W. F. MASSEY, *full of valuable information to the farmer. The address:*

The farmers too often imagine that they can send some poor soil to the State Chemist, and he can then tell them just what it needs to make it fertile and productive. He can do nothing of the sort. He can tell you what elements your soil contains, but his analysis would not inform you in regard to the availability of the plant food in the soil, and he may show you that your soil contains an abundance of plant food for the production of crops, and yet you know that it is unproductive and what is termed worn out. The only man who can tell what any particular soil needs is the farmer who cultivates it, and he can do it only by a careful study and experimentation. Farmers all over the country are buying materials as fertilizers by guess work, and do not know whether their soil needs all the ingredients that they are paying for or not. The man who is content to go along year after year planting the same land and dribbling a little fertilizer in the furrow merely to get a little more out of the soil to sell is not farming at all. He will tell you that his land is poor, though he has been cultivating it for many years, and does not seem to realize that it is poor because he has been making it so every year he has cultivated it. Any man who is farming on land that was originally fertile should be ashamed to tell people that his land is poor. It is simply acknowledging that he is a poor farmer who does not understand his business, for a really good farmer is one who gets annually large crops while his land grows more fertile by reason of his management. The farmer who is not improving his land is going backwards, for there is no middle ground. The land must improve in cultivation or lose fertility. There has been so much of investigation of fertilizers and their action on crops that there has grown up an impression that for every crop planted we must have a special commercial fertilizer, and year after year the fertilizer manufacturers have grown rich while the farms and the farmers have grown poorer. Fertilizers have a great value in the improvement of the soil if properly used, but the gambling on the chances with a little fertilizer annually, less than the crop can use, resulting in its drawing still more on the natural store of food in the soil, has been followed by the depletion of the soil till it is regarded as worn out. That same soil, when it was first cleared from the forest, was mellow dark in color, and held moisture longer than it now does. It did not bake hard after a rain and did not wash into gullies. But the soil robber who calls himself a farmer worked the soil year after year in clean cultivated crops till the moisture—retaining black vegetable matter or humus—was all burned up, and

the clay soil runs together and gets hard after rains because it cannot hold on to the moisture as it formerly did. Then being scratched over a few inches deep with a single mule and a boy Dixie plow, when the rains come the shallow loose soil gets full of water, and the sub-soil being too hard for it to sink, it runs down hill and starts a gulley, and winter after winter the frost loosens more of the hard clay and washes it down to make the gully deeper, till finally the field is so full of gullies as to be past redemption. We can see this all over the South. And in the vain attempt to stop the gullies we build terraces and make hillside ditches, when the real cause of the gullies, the shallow plowing, is entirely overlooked. Terraces as a temporary aid in the restoration of an abused field are all right, but more can be done to check the waste of the land and the formation of gullies by proper plowing than by terraces. I have cultivated red clay hills as steep as can be cultivated anywhere and worked them without any terracing and stopped old gullies that had begun to form simply by deep breaking and subsoiling to give a deep bed of loose soil that will hold more rain water without moving, and will retain it there for crops instead of letting it run down hill. I had rather do away with terraces altogether than to depend on terraces with the one mule to break the soil. Then, too, as I have said, the new land did not wash, because it was full of humus and fine roots. Now, if we restore these new ground conditions through the accumulation of humus in the soil and add to this better plowing, there would be no need for terraces or hillside ditches. Another practice that has helped our lands to wash is the way in which crops of cotton or corn have been cultivated on them. The crops are hilled up with a plow and laid by, and when the rains descend and the floods come every dead furrow thus made becomes a reservoir of water till finally one up the hill breaks away and floods the next furrow and it breaks, and down the hill the flood rushes to start a gully. If the crops had been cultivated shallow and as level as possible, these basins for the collection of the flood would not have been made, and there would have been no place for the water to gather a head. I have spoken of these things in order to point out the errors which have caused the land to need improvement. Taking our upland red clay for example, how shall we proceed to redeem the waste. Since our red clay is the result of the decomposition of the rocks on which it rests, it is naturally of the same composition all the way down, with the exception of what has been added to the surface or robbed from it. In fact, as I have often said, our upland red clay soil is all good soil down to the fast rock if we once get it for a time within the oxidizing influences of the air and the mellowing of the frost. The first effort then in the improvement of such a soil will be deeper breaking and a loosening of the hard clay below the breaking plow with a subsoiler. This deepening should always be done in the fall for two reasons: The subsoil is dryer then than in spring and will crumble under the action of the subsoiler, while in spring it would be so wet, even when the surface is in good order, that the subsoiler would plaster the clay instead of loosening it. Secondly, the deeper turning will bring up some soil not heretofore turned, and this should be exposed to the winter frost to prepare it better for plant life. Then we should fix upon a regular rotation of crops and adhere to it year after year. This rotation should be planned with a view to give the money crop of the farm the most favorable place for its development and its

increased yield. This is, or should be, the object of any rotation, to increase the productiveness of the land, especially in the money crop, while growing increasing crops of the other crops that help in the increase.

Now, after having thoroughly plowed and subsoiled the land late in the fall, do not leave it lie bare all winter, for in our climate there is always a little nitrification or formation of soluble nitrates going on in the soil, and these are quickly leached out by the winter rains unless some green plant is at hand to use them. Starting with thin and worn land, probably the best cover crop that can be used will be rye. This should be sown quite thickly, so as to cover all the soil by spring time. On this rye get out all the home-made manure and spread it as far as you can make it go broadcast. A manure spreader is a valuable implement, as it finds the manure and spreads it more evenly than can be done by hand. Having replowed the land in the early spring and turned under the rye, plant the land in corn. You could make more corn by giving it a good dressing of a complete fertilizer, but you will pay for all the corn you get, for in all the experiments I have ever made the increase in the corn crop from the use of commercial fertilizers never paid for the fertilizer used. I would rather depend on the rye turned under and what manure could be applied with the deep preparation of the soil for the corn crop than to use commercial fertilizer on it. Just ahead of the last cultivation, the cultivation having been done from the start with smoothing harrow, weeder and cultivator, and no plow allowed in the field, sow cow peas and cultivate them in among the corn. Cut the corn off at the ground when well glazed and cure in shocks, and if you have a heavy growth of peas, mow them for hay, and then with the cutaway harrow chop the surface of the corn land as completely as possible, but do not replow it. Work in at this time 400 pounds of acid phosphate and twenty pounds of muriate of potash per acre, and after the first frost sow wheat. When this wheat is harvested, at once sow peas again on the land broadcast at rate of one bushel or one and a quarter bushels per acre, and when they begin to show yellow pods mow them for hay.

If when sowing the peas another dressing of the acid phosphate and potash is added, the growth will be greatly helped and the peas will fix all the more nitrogen in the soil for the following crop. On this pea stubble in September sow fifteen pounds per acre of crimson clover seed and brush them in lightly with the smoothing harrow. As soon as these begin to show bloom in spring turn under and prepare the land for cotton. For this cover crop the burr clover will answer as well as the crimson clover, but if forage is scarce, the crimson clover will come in well for hay. But we are considering the bringing up of poor land, and we want to get all the organic matter into it that we can. While I never advise the turning under of green crops in summer for a sown crop in the fall, we can always safely turn under a green growth in spring to be followed by a hoed crop. The preceding crop of peas and the winter crop of clover will have given all the nitrogen needed for cotton, and you now need only to use the same mixture of acid phosphate and potash on the cotton crop, and the larger part of it should be used between the rows, and not in the furrow, for cotton roots forage far and wide and need something to sustain them at fruiting time as well as at the beginning. Now, at last working of the cotton sow crimson clover or burr clover again all among the cotton

for a winter cover, and on this get out during the winter all the increased manure you have been able to make through the feeding of the pea vine hay, fodder and clover, and spread it broadcast for the corn in the spring. By this time that old worn out land will be in condition to make a fair crop of corn if you get a well bred variety that can be planted closely and is at the same time a productive sort. Now repeat the rotation as before, always putting peas among the corn and clover among the cotton, and always making sure to have something green growing on the land in winter to avoid the loss of fertility that is sure to take place in bare land. You will notice that I have not advised the use of any complete fertilizer containing ammonia or nitrogen. In buying a complete fertilizer you pay about as much for the ammonia that is in it as for all the rest, while by practicing the rotation suggested and growing legume crops frequently on the land you can avoid the need for the purchase of an ounce of ammonia, and will at the same time be gradually getting your land nearer and nearer to the black humus condition it had when first cleared. You will find that year after year it works easier, stands drought better and crusts less and less, and by the time you have passed through the second round of the rotation you will find that all the fertilizer you need to buy will be a liberal application of the acid phosphate and potash for the peas following the wheat, and you will be able to feed more stock from the abundance of forage grown, and as a consequence will be annually making more manure for the corn crop, and will make more cotton without fertilizing than you formerly did with the little sprinkle applied annually to a worn out soil. The best way to rest and recuperate land is to keep it busy between sale crops growing something that will help the land and feed the stock. Then when you get to using the fodder shredder you will be getting still more feed out of the corn crop, and finally you will build a silo and put a large part of your corn crop into it and feed still more stock, for be assured that any system of farming that does not produce forage for cattle, and which ignores the feeding of stock of some sort is not a good system and leads to impoverishment and poverty of soil and farmer alike. When, through the short rotation advised, you have finally gotten your land into a productive state you can lengthen the rotation and have two wheat crops, one after corn and one on the pea stubble. Of oats I have said nothing, but on lands not adapted to wheat the winter oats crop can well be substituted and the rows occupied by the corn shocks in the fall can be utilized for sowing oats in the spring after the corn has been removed. When you get impressed with the need for still more forage, you can put a piece of the best land in alfalfa as a permanent mowing field, after having grown a crop of burr clover on it the season before, sowing the clover one fall and alfalfa next. The important matter to consider is

LIFE IN THE SOIL.

A fertile soil is of necessity a living soil, a soil abounding in forms of life which are engaged in helping the farmer in his work, and a run down and poor soil is largely so because these forms of life have been starved out of it, and it is literally a dead soil in which there may be an abundance of plant food, as shown by a chemical analysis, but in such a condition that plant

roots cannot use it, and hence it is common to call it a worn out soil. But that nature, unaided, will in time restore the productiveness of soils formerly fertile we have often seen through the agency of the broomsedge and the pine tree in the South. The broom sedge and the pine tree bring back to the worn soil the conditions that make microscopic life possible again in the soil by furnishing it anew with the organic decay that greedy man has robbed it of, and the success of any effort of man to restore the worn lands depends on the extent to which he imitates nature, and brings back the new-ground conditions to the land, as the pine tree does through long years, and he must learn to do it in a shorter time, for the needs of modern agriculture will not allow us to wait the slow process of the broomsedge and the pine tree, though we find our tobacco growers still accepting what the pine tree does for them, and clearing up thickets for tobacco growing, instead of adopting a rational and systematic way for restoring bacterial life to the soil. That word bacteria has been bandied about so much in all the papers of late that every one has become familiar at least with the name, though unfamiliar with the real work done by bacteria in the soil. Therefore, I propose to talk to-day about these living things and their use in agriculture. A bacterium is the smallest of all known plants. In fact, there may be some so small that the highest powers of our best microscopes have not yet identified them, and they may yet be found to be responsible for many things that occur in the soil which are as yet unaccounted for. Whether there are really many distinct species of bacteria, or whether all the forms are merely modifications of one species, is a matter not yet fully decided by scientists. But we know that certain forms have been recognized as doing certain work in the soil, and certain others doing another work, and that neither does the work of the other, so that they certainly have become adapted to certain modes of growth and the doing of certain things as positively as though they belong to entirely different species. One of the chief works done by bacteria in the soil is the breaking down of organic matter buried therein and the transferring of the organic nitrogen in this organic matter into nitrates which green plants can feed upon. It has been pretty definitely determined that the plants that make our crops do not use ammonia as such, but that whatever form nitrogen is placed in the soil it must pass through the process which has been called nitrification. There is more than one form of bacterium engaged in this work. One form is engaged in the breaking down of the vegetable or animal matter that may be turned into the soil and thus releasing ammonia. Then another of these microscopic forms of plant life feeds on the ammonia, and the result is the formation of what are called nitrites. This form goes no further, but another form takes up the work and feeds on the nitrites and nitric acid is the result of their oxidation work. Then, as there is always present in the soil lime or potash or some other base of an alkaline nature, the result is a nitrate, a very readily soluble form of nitrogen, as we know from our experience with the nitrate of soda, and the nitrogen is now ready for crops to use, and it must be used by them quickly or it is washed from the soil into the drainage waters, for while a soil will hold on to phosphorous and potassium till some plant calls for them, the nitrates are fleeting. And in our soils, wherever they are well supplied with humus or organic decay, there is always more or less of this change into soluble nitrates going on. Hence the

great need in the South especially for a green winter crop on the soil to catch the fleeting nitrogen, so that it can be returned to the soil and pass again through this process of nitrification for the succeeding crops.

Now, when by a long series of years of constant cropping and exposure of the soil to the sun—for the sun is one of the chief agents in the destruction of bacterial life, whether harmful or beneficial—the organic decay or humus is used up, the bacteria which live on their work of nitrification are starved out, and what was really a living soil when cleared from the forest becomes really a dead soil, and the farmer goes on buying in an expensive manner the nitrogen which he might have had free had he treated his soil better.

But there are still other forms of these minute plants working for us if we only give them the chance. The work of those we have mentioned depends on the presence of decaying organic matter in the soil which contains nitrogen. There are others which are engaged in enabling the crops that form this organic matter to get more nitrogen than would ordinarily be found in such plants without their aid.

For many years it was known that in some way the plants belonging to the botanical order, Leguminosae or pod bearers, the plants represented by our cow peas, clover, locust trees and other plants which form their seed in pods, large or small, did add fertility to the soil in which they grow. Many years ago I was familiar with an old farm on which all the fence rows were planted with rows of yellow locust trees, and it was the common remark that these locust trees did not seem to do so much harm to crops as other trees. In fact, the clover and blue grass seemed to flourish better near them than elsewhere, and only in exceedingly dry seasons did they seem to harm corn growing near them. Every one knew that clover did in some way help the land, and the notion grew that it absorbed ammonia from the air through its leaves. Careful experiments by scientific men soon showed that clover did nothing of the sort, and then the scientists all over the world began to study these legumes in order to discover in what way it was that they did acquire nitrogen, for it was evident that they did do this in some way. After while it was found that when there were certain little knots or nodules on the roots of these plants, they did get more nitrogen, and when none of these were there the legumes did not get any more nitrogen than any other plants. The conclusion then was irresistible that these nodules had something to do with the acquisition of nitrogen from the air, and the scientists devoted their attention to the nodules. It was found that the nodules were the homes of certain minute plant forms. From their difference in form to any bacterium which had before been studied they were at first called bacteriods, or something resembling a bacterium. But the final conclusion seems to be that they are really bacteria altered in form through their peculiar work on the plant. Since the legumes were found entirely unable to acquire nitrogen from the air without the aid of these plants, it became evident that in some way they are the agents for the getting of the nitrogen from the air and locating it as organic nitrogen in the plants. Just how they do it is yet one of the undiscovered secrets of nature. One plausible theory is that, like the yeast plant, which oxidizes sugar solutions and forms alcohol by fermentation, these little forms are nitric ferments, oxidizing the free nitrogen that per-

meates the soil with the air and form nitric acid, which at once seeks a base in the soil and forms a nitrate which the legumes take up at once. One evidence of this is that corn among which peas are sown does not suffer, but is rather benefited by them unless the weather is so dry as to cause them to take too much moisture from the soil, and it would seem that the corn, as well as the peas, gets some of the nitrate formed. However this may be, it is sufficient for all practical purposes to know that the legume crops do get for us and leave in the soil in their decay an additional supply of nitrogen that would not otherwise be in the organic matter deposited in the soil. Knowing this, does it not become the part of wisdom for the practical farmer to take advantage of the fact, and to so order his cropping that his soil shall get the largest benefit of the nitrogen thus acquired free of cost? And not only free of cost, but enabling him through the proper ultilization of these plants to furnish his stock with the best of forage while improving his soil for the following crop. And right here comes in again the work of the bacteria of which I first spoke. The nitrogen which the legume crops acquire is not in the readily available form of a nitrate after the legume have taken it up, and the bacteria which are engaged in the nitrification work find in the matter left in the soil an abundance of the food they need. It is one of the greatest evidences of an Almighty Power which orders nature that this nitrogen that has gotten into the soil in this way is not at once available since it is left in the organic matter of the peas or clover or other legume crop, and must pass through the process of decay and nitrification before plants can use it. If the legumes got it as a nitrate, they have safely stored it away for the future. If all was left in the soil as a nitrate, there would be little, if any, left for the crops the next season. But being there in the form of humus-making organic matter, it furnishes material for the encouragement of beneficial life in the soil, and the plants of the succeeding year get it when needed.

The question now occurs, what is the best use that the farmer can make of these nitrogen-catching bacteria which live with legume plants? I am frequently asked will it not do more good to bury the whole crop of peas or clover or other legume in the soil than to cut the crop for hay? This will depend on the particular condition of the farm and the farmer. In the first start in the improvement of a dead soil, from which all the humus has been worn out, it may be a matter of economy to more rapidly get the humus-making material back into the soil. But when one has his land in a fair course of improvement I am sure that the best farm economy is served by the use of the crop first as food for stock. The great lack in our Southern farming, especially in cotton farming, is the ignoring of the feeding of live stock, which lies at the very foundation of successful agriculture, no matter what the money crop may be. When one has gotten his land to produce a ton or more of good pea vine hay or clover hay per acre, its feeding value is too great to warrant its use simply as manure. And we do not lose this manurial value by feeding it, for if we save the manure with any sort of reasonable care, we can at least save 75 per cent. of the manurial value of the crop after getting and using its feeding value. So long as hay sells for $18 to $20 per ton in the South it will not pay to bury a ton or more per acre as manure. The manure made from the feeding of the legumes has á far higher value than that from the common roughage of corn fodder and cotton seed hulls,

and it furnishes what commercial fertilizer do not, food for the bacteria that keep up the fertility of your soil and prevent its becoming a dead soil from their being starved out. This humus which is the one thing that keeps life in the soil is the one thing most generally lacking in our old soils, and through the legume plants and their profitable feeding is the best road for the restoration of life to the old dead soils.

What legumes are best for the Southern farmer? Fortunately we can grow more of these and a greater variety than in any other part of the whole country. The greatest of all of these is the cow pea, for which I have battled here for the past fifteen or more years. It is emphatically the "clover of the South," the crop which will enable the Southern farmer to do for his land all that clover can do for the Northern farmer, and to do it in one-fourth the time that the Northern farmer can with clover. I have no word to say against clover, for where it succeeds well it is one of the most indispensable of legumes. But in the greater part of the cotton country especially clover does not thrive, and in the improvement of run down soil we must at first make use of the pea in order to get the land to grow clover well. Peas, too, will thrive on lands somewhat acid, while clover will not, and much of our old land has gotten into an acid condition and needs lime, which in many parts of the State is hard to get and expensive at best. Then, too, we find lands so impoverished that even the pea will not make much growth on them. There, then, is the place where the farmer who looks to the improvement of his soil can best afford to use fertilizers, and experiments made in other States seem to show that it may become economical and profitable to use the pulverized phosphatic rock or floats instead of acidphosphate. True, the chemists tell us that the phosphoric acid in the pulverized rock is insoluble, but the chemists do not know all that goes on in the soil, and it is known that in some way the plants do use this insoluble rock phosphate, though slower about it perhaps than in dissolved rock. But whatever is used, the legume crop is the place where it will have the greatest effect in the improvement of the soil, and we can use the mineral forms of plant food in phosphoric acid and potash to enable us to get more food for stock and more nitrogen from the air without buying it in our fertilizers, and if we get this increased growth, we can depend on the legume to do the getting of the money crop for us, and by feeding it well we can through the manure made become annually more and more independent of the fertilizer factory, having one right in our own barn. Valuable as the cow pea is and indispensable as it is in Southern agriculture, it is not the only legume we can grow. After taking a cow pea crop from the soil we can sow crimson clover on the stubble, a winter-growing plant, that will act as a soil protector and a nitrogen collector and can be turned under with success in the spring for a hoed crop of corn or cotton. Then among that cotton we can sow the burr clover, a sort of annual alfalfa, which will also make a winter cover and be ready to help the corn crop in the spring. Then another forage crop we can use is the hairy vetch. But this, though very valuable when sown with small grain in the fall for a hay crop in the spring, is of such a nature that we do not any longer advise its use where the wheat crop is of any importance, since it may become, and has in some places become, a veritable pest in the wheat fields, it being difficult to separate the seed from the wheat. Vetch, you know, is what

A PROFITABLE HAY CROP 2 1-2 TONS PER ACRE.

the Bible calls tares, which the enemy sowed in the man's wheat field. But where wheat is not a crop of any importance, the hairy vetch is a valuable forage plant sown with wheat or oats in the early fall and cut for hay. But the great use for any legume in the South at present is in an improving rotation for the development of the productivity of the soil, and the feeding of live stock, and for these purposes I know of no crop that can compare with the field pea of the South, and it is upon this crop that most of us must depend.

You have heard a great deal of late in regard to alfalfa. We have learned a great deal of late years in regard to alfalfa. In my boyhood I knew of a great many efforts to grow what was then called lucern, but to which the name alfalfa has of late years been fixed. So many were the failures that I came to the conclusion that it was useless to attempt the growing of the crop in the eastern section of the country. But some years ago I was in New York and was invited by the firm of Peter Henderson & Co. to visit their grass and clover-testing farm on the Hackensack river, in New Jersey, where they devote a large area of land to the testing of all the grass and clover seed they sell. I went out there, and was greatly interested in looking over the various plots of grasses and clovers. Among these I found an acre plot of very fine alfalfa. I asked them to tell me how they made it grow. They said that the summer before it had turned yellow, and looked like dying, but that in hauling some lime to a plot above it some sifted from the wagon on one corner of the alfalfa, and at once it turned green there. Noting this, they spread lime over the whole of it, and it responded finely to it. In the arid regions of the West, where alfalfa is such a success, the lime has not been washed from the soil, but is there in great abundance, and alfalfa is a lime-loving plant, as most legumes are, if we except the cow pea. Some months after that I travelled at several institutions in the State of Maryland in company with Mr. J. E. Wing, of Ohio. Mr. Wing had formerly been ranching on the plains of Colorado till the sheep men drove the cattle off, and he came home to Ohio, and determined to make the sheep that had driven him out of the cattle business repay him. He determined to grow alfalfa there and feed range lambs. After a few failures he found that he could grow it. He found that when sown in the spring it was necessary to keep mowing it off the first season to keep down the grass and to strengthen the roots. He and his brother went on year after year growing more and more alfalfa till they have quite a large farm in alfalfa and make a business of feeding range lambs from Colorado during the winter for the markets, and are making money at it, usually feeding 1,200 to 1,500 every winter.

This brings me to the last point in this discussion, the inoculation of the soil for legumes. The daily papers and the magazines have of late been filled with wonderful accounts of what has been called a great "discovery," the artificial cultivation of the bacteria which are parasitic on the roots of legumes. The laboratory culture of bacteria is nothing new, for it has been done for a generation or more, and it has been well known that many of these can be dried and kept dry for a long time and survive so that when again placed in a nutrient solution they will begin to grow and increase rapidly. The only new thing about the whole business is the sending of the dry bacteria in cotton with packers of nutrient material to use in increasing them

It has been found that whether they are really distinct species or not, many of these bacteria have been accustomed to living on certain species of legumes that they are slow at least to live upon others, and hence in the making of these cultures the aim was to make separate cultures of the bacteria common to different species of legumes separately. There never was a scheme so abundantly advertised without cost to the originators. For a time the cultures were sent to all farmers applying to the Department of Agriculture in Washington free of cost. But the temptation for commercial enterprise in the matter was too strong, and soon the business was transferred to a company who put up the cultures under the name of nitro-culture and charged $2 for each culture, which cost perhaps three cents in its preparation, and farmers were instructed that by putting the bacteria in the solutions and encouraging their growth there would soon be enough of them to inoculate the seed for an acre of alfalfa, clover, cow peas or what not. But many experiments have shown that the artificially bred bacteria do not seem to take to the soil readily, and that the use of these cultures has almost uniformly resulted in failure, and aside from the scandal that has been created, the bacteria are comparatively worthless for practical use. One farmer who occupies a prominent position in the Department of Agriculture tried the nitro-culture in comparison with natural soil bacteria from land where alfalfa had been grown with success, and where the bacteria were abundant in the soil. This soil he scattered in a broad band around a plot of land sown to alfalfa, and in the centre of the plot he used the nitro-culture from its Department. Where the bacteria-laden soil was used he has an abundant growth of alfalfa, but where the nitro-culture was used none at all. Similar results have been had elsewhere, and it is evident that nitro-cultures will soon be relegated to the same neglect that the "nitragin" that was introduced from Germany years ago for the increase of the nitrifying bacteria in the soil, but which also failed. The fact is that the sole use of inoculation is to enable the plants to get the free nitrogen from the air. If they are supplied abundantly with nitrogen in the soil they will grow all right, but will not do any collecting on their own account, and hence make no increase in the soil nitrogen. In the words of one investigator, they get lazy, and take what is provided for them and fail to get that from the air.

It remained for North Carolina to demonstrate a better way for the inoculation of the soil with the alfalfa bacteria. It was found that at the Edgecomb farm the seeds of burr clover, when sown in the burr, carried with them the bacteria, and that the soil thus became inoculated, both for the burr clover and its near relative alfalfa. Hence it would seem that we can inoculate the soil for alfalfa by getting soil from a field where the burr clover has grown, or perhaps it would do as well to sow some burr clover seed along with the alfalfa seed. The sweet clover or melilotus alba is a common weed in many parts of this State, and the soil where it grows is said to contain bacteria which will inoculate alfalfa. Hence there is no need for sending two dollars an acre up North for bacteria in cotton either for alfalfa or any other legume. The hairy vetch can be inoculated by using soil from any old garden where English peas have long been grown, and crimson clover seed sown in the rough will inoculate the soil for itself

and for red clover, and for our cow peas there is no need for inoculation, in the South at least, for we have very little, if any, soil that is not abundantly inoculated for them, if they have been grown to any extent on the farm, and the large seed probably carries with it in the accompanying dust an abundant supply of the suitable bacteria. I used this season one sample of the nitro-culture on cow peas, and can not only not see any benefit from it, but the part of the plot not treated is actually better than the treated plant. Sown on very strong land, that has for years been heavily manured, no legume will make many nodules, since they depend, as we have said, on the nitrogen they find abundant in the soil, and there is at least one of our garden legumes on the roots of which no nodules have ever been found. This is the lima or butter bean, and any one who has been familar with this bean knows how well it agrees with abundant manuring and seems to need it. In conclusion, let me say that the successful farmer of the future must be a legume farmer. Nearly forty years ago I made this same remark to a gathering of farmers in Maryland, and as the years have passed I have seen no reason to modify it. A short rotation of crops in which the legumes come in frequently on the land and are aided by the mineral elements of plant food to increase the crop of forage, and the feeding of this forage to live stock, is the only way to increase the productivity of our lands, and to make the farmer more independent of the fertilizer factory, and the farmer who diligently sticks to such a rotation will soon have an ambition higher than is ascribed to the president of the Cotton Growers' Association, who was recently quoted as saying that he is perfectly satisfied to average half a bale per acre. Two bales per acre should be the ambition of the cotton farmer, and at least one rotative farmer not far from Raleigh made this last year over fifty acres. With such a posibility from good farming, why should half a bale satisfy any farmer?

Barnyard Manure.

A Very Important Subject to Every Farmer.

MANURE AS A FARM RESOURCE.

A well-kept manure heap may be safely taken as one of the surest indications of thrift and success in farming. Neglect of this resource causes losses, which, though vast in extent, are little appreciated. Waste of manure is either so common as to breed indifference or so silent and hidden as to escape notice.

Experiments indicate that if farm animals were kept in stalls or pens throughout the year and the manure carefully saved the approximate value of the fertilizing constituents of the manure produced by each horse annually would be $27; by each head of cattle, $19; by each hog, $12, and by each sheep, $2.

These estimates are based on the values usually assigned to phosphoric acid, potash, and nitrogen in commercial fertilizers, and are possibly somewhat too high from a practical standpoint. On the other hand, it must be borne in mind that no account is taken of the value of manure for improving the mechanical condition and drainage of soils, which, as the subsequent pages will show, is fully as important a consideration as its direct fertilizing value.

Discussing this subject from a more practical standpoint, Prōfessor Roberts has suggested $250 as a conservative estimate of the value of the manure produced during seven winter months on a small farm carrying 4 horses, 20 cows, 50 sheep, and 10 pigs.

If we assume that one-third of the value of manure is annually lost by present methods of management, and this estimate is undoubtedly a conservative one, the annual loss for each farm would amount to $83.33.

It should be clearly understood that when the farmer sells meat, milk, grain, hay, fruits, vegetables, etc., from his farm, or neglects to save and use the manure produced, he removes from his soil a certain amount of potash, phosphoric acid, and nitrogen that must be restored sooner or later if productiveness is to be maintained.

The following table compiled by Armsby shows the amount and value of fertilizing constituents carried away from the soil in different products:

Manurial Value of Farm Products.

	Pounds per ton.			Value per ton.				Manurial value of $10 worth.
	Nitrogen.	Phospho-ric acid.	Potash.	Nitrogen.	Phospho-ric acid.	Potash.	Total.	
Meadow hay	20.42	8.2	26.4	$3,47	$0.57	$1.06	$5.10	$5.10
Clover hay	40.16	11.2	36.6	6.83	0.78	1.46	9.07	9.07
Potatoes	7.01	3.2	11.4	1.19	0.22	0.46	1.87	0.12
Wheat bran	49.15	54.6	28.6	8.35	3.82	1.14	13.31	8.32
Linseed meal	105.12	32.2	24.8	17.87	2.25	0.99	21.11	7.54
Cotton-seed meal	135.65	56.2	29.2	23.06	3.93	1.17	28.16	10.05
Wheat	37.53	15.8	10.6	6.38	1.11	0.42	7.91	2.63
Oats	36.42	12.4	8.8	6.21	0,87	0.35	7.43	3.86
Corn	33.06	11.8	7,4	5.62	0.83	0.30	6.75	3.78
Barley	39.65	15.4	9.0	6.74	1.08	0.36	8.18	3.03
Milk	10.20	3.4	3.0	1.73	0.24	0.12	2.09	0-88
Cheese	90.60	23.0	5.0	15.40	1.61	0.20	17.21	0.69
Live cattle	53.20	37.2	3.4	9.04	2.60	0.14	11.78	1.18

We learn from the above table (says Armsby) that the farmer who sells a ton of hay, for example, sells in this ton of hay fertilizing ingredients which, if purchased in the form of commercial fertilizers, would cost him about $5.10; that if he sells 2,000 pounds of wheat he sells an amount of nitrogen, phosphoric acid, and potash which it would cost him $7.91 to replace in his soil in the form of commercial fertilizers. Or, looking at it from a somewhat different standpoint, a farmer who sells, for example, $10 worth of wheat sells with it about $2.63 worth of the fertility of his soil. In other words, when he receives his $10 this amount does not represent the net receipts of the transaction, for he has parted with $2.63 worth of his capital, that is, of the stored-up fertility of his soil, and if he does not take this into the account he makes the same mistake a merchant would should he estimate his profits by the amount of cash which he received and neglect to take account of stock.

If the farmer, instead of selling off his crops, feeds them to live stock on the farm as far as possible, a large proportion of this fertility, as has been shown above, is retained on the farm; and "if the business of stock feeding is carried to the point where feed is purchased in addition to that grown on the farm, a considerable addition may in this way be made to the fertility of the farm at an almost nominal cost, since it is assumed that feed will not be bought unless its feeding value will at least pay its cost." This commendable system of indirect purchase of fertilizers in feeding stuffs is practiced largely in England and other European countries, and accounts for no small share of the profits of stock-raising in those countries.

But it is evident that these advantages will not be secured unless the manure produced is carefully saved and used.

The growing of more leguminous plants, such as beans, peas, clover, lupines, etc., as a means of increasing the fertility of the soil, is strongly recommended both from theoretical and practical considerations, but as a recent farmers' bulletin (No. 16) of the Department says:

The leguminous crop is best utilized when it is fed out on the farm and the manure saved and applied to the soil. The greatest profit is thus secured

and nearly the same fertility is maintained as in green manuring. * * * The farmer should mend his system so that the barnyard manure will be as well cared for as any other farm product. Loss from surface washing, leaching, fermentation, and decay should be guarded against. Then the feeding of richer food will mean richer manure and better and cheaper crops.

It is hard to persuade the farmer to abandon time-honored practices and adopt methods with which he is unfamiliar. He also hesitates about incurring the necessary expense of building suitable receptacles for the storage of manure, frequently assuming that this is greater than it really is. As Roberts states "the new idea that the manure should be as carefully preserved from unnecessary waste as any other product of the farm is hard to put in practice, after having stored for forty years the farmyard manure under the eaves upon the steep hillside which forms one border of the running brook."

The waste of barnyard manure.

If your barnyard is like this one, you are losing a hundred dollars in fertilizers every year.

It is to be feared that the introduction of commercial fertilizers has not been without effect in increasing the apparent indifference with which this valuable farm resource is so often regarded. Too many farmers lose sight of the fact that, as a rule, commercial fertilizers should supplement and not entirely replace the manurial supplies of the farm.

AMOUNT, VALUE, AND COMPOSITION OF MANURE PRODUCED BY DIFFERENT ANIMALS.

It is of great importance to the farmer to know the amount and value of manure which will be produced in a given time by animals of different kinds, and various methods of calculating these approximately have been proposed. Some authorities base their calculations upon the amount of straw used as litter, assuming that for one ton of straw used as bedding four tons of manure will be produced. Armsby shows, from carefully conducted experiments with horses, that where straw is used as economically as possible each horse will require 2,500 pounds of straw per year for bedding purposes. Using this as a basis, he calculates "that a ton of wheat straw, economically handled, may result in six tons of fresh manure," but under ordinary circumstances it will probably not result in more than five tons. "In stables

where but one or two horses are kept or where the manure is infrequently hauled away, the product might not greatly exceed two and a half tons when the time came to remove it."

Probably the most accurate method which has been used is that adopted by Heiden and others, which bases all calculations upon the amount of food consumed and litter used.

The dried excrement of horses, cows and other neat cattle, and sheep, is nearly one-half of the dry food consumed. One hundred pounds of dry matter in food consumed by horses yields 210 pounds of manure, containing on an average 77.5 per cent. of moisture. To this should be added the weight of bedding (amounting to about 6 1-2 pounds per day) in order to get the total product of manure. Making allowances for dung and urine dropped outside of the stable, Heiden calculates that a well-fed working horse will produce fifty pounds of manure per day, or six and one-half tons per year, which can be saved. Boussingault's and Hofmeister's figures indicate this amount to be five and one-quarter to five and one-half tons, while Armsby's put it at about six and one-third tons. Cows and other neat cattle produce manure containing on an average 87.5 per cent. of water. One hundred pounds of dry matter consumed in food yields 384 pounds of manure, to which must be added the amount of litter used, which, according to Heiden, should be about one-third of the dry matter fed. Calculating on this basis, a steer weighting 1,000 pounds and consuming twenty-seven pounds of dry matter per day would produce about twenty tons of manure per year.

Sheep excrete 49 1-3 per cent. of the dry matter of their food. The manure contains on an average 73 per cent. of water. One hundred pounds of dry matter in the food would therefore produce 183 pounds of manure. A sixty-pound sheep fed two pounds of dry matter and receiving three-fifths pound of bedding would produce about 4.1 pounds of manure per day, or three-fourths ton yearly.

Careful observations have indicated that the pig produces from twelve to sixteen pounds of manure per day, or from two to three tons per year.

The following table compiled from a bulletin of the New York Cornell Station shows the amount and value of manure produced by the principal kinds of farm animals fed liberally and given sufficient bedding to keep them clean, calculated to a uniform basis of 1,000 pounds live weight:

Amount and value of manure produced per 1,000 *pounds of live weight of different animals.*

	Amount per day.	Value per day.*	Value per year.
	Pounds.	Cents.	
Sheep	34.1	7.2	$26.09
Calves	67.8	6.2	24.45
Pigs	83.6	16.7	60.88
Cows	74.1	8.0	29.27
Horses	48.8	7.6	27.74

* Valuing nitrogen at 15 cents, phosphoric acid at 6 cents, and potash at 4½ cents per pound.

The fertilizing constituents and the value per ton of the manure obtained under the above conditions are shown in the following table, in which

is inserted for comparison the results of analyses by Storer of manure and hens, which is representative of fowl in general:

Analyses and value per ton of manure of different animals.

	Water.	Nitrogen.	Phosphoric acid.	Potash.	Value per ton.
	Per cent.	Per cent.	Per cent.	Per cent.	
Sheep	59.52	0.768	0.391	0.591	$3.30
Calves	77.73	0.497	0.172	0.532	2.18
Pigs	74.13	0.840	0.390	0.320	3.29
Cows	75.25	0.426	0.290	0.440	2.02
Horses	48.69	0.490	0.260	0.480	2.21
Hen manure	56.00	0.80 to 2	0.50 to 2	0.80 to 90	7.07

These figures probably fairly represent the actual fertilizing value of the carefully preserved manure (both solid and liquid) of well fed and cared for animals. In all cases the manure was protected from leaching and in some cases treated with a small amount of gypsum as a preservative. "It will be noticed that the average amount of nitrogen recovered in all the manure is considerably more than that of the potash and about twice the amount of phosphoric acid."

In general practice the manure from the different kinds of animals is frequently collected in a common heap until needed. While it is difficult to state an average, mixed barnyard manure properly cared for may be safely assumed to vary in composition within the following limits:

	Per Cent.
Nitrogen varies from	0.4 to 0.75
Phosphoric acid varies from	0.2 to 0.40
Potash varies from	0.4 to 0.75
Water varies from	70 to 80

COMPARATIVE VALUE OF SOLID AND LIQUID PARTS.

It is a fact often lost sight of in practice that the urine of animals is by far the most valuable part of the excreta. The solid excreta contains, principally, the fertilizing constituents of the food which have failed to be digested or absorbed into the animal system and are, therefore, chiefly in insoluble forms. The urine, on the other hand, contains those fertilizing constituents which have been digested and are largely soluble. The composition of the urine, like that of the solid excreta, varies with the kind and age of the animal, but especially with the nature of food, water drunk, etc., as will be explained later. The composition of the urine of different kinds of farm animals has been found by analysis to be as follows:

Chemical composition of the urine of different animals.

	Water.	Nitrogen.	Phosphoric acid.	Alkalies.
	Per cent.	Per cent.	Per cent.	Per cent.
Sheep	86.5	1.4	0.050	2.0
Swine	97.5	0.3	0.125	0.2
Horses	89.0	1.2	.....	1.5
Cows	92.0	0.8	.....	1.4

The urine of farm animals may be said to be free from phosphoric acid except in case of sheep and swine, where it occurs in minute traces, but is rich in nitrogen and the alkalies (including potash and soda); consequently it is an incomplete manure and should be supplemented by phosphates if used alone. It is best, however, to apply it along with the solid excrement, which contains a considerable amount of phosphoric acid. This latter fact helps to explain why leachings from rotted manure are more valuable as a fertilizer than urine alone. The leachings contain in addition to the constituents of the urine the soluble constituents of the solid manure, among which is a considerable amount of phosphoric acid.

The comparative value of the solid and liquid excrement is shown in the following table:

Composition of solid and liquid excrement of farm animals.

	Water.		Nitrogen.		Phosphoric acid.		Alkalies (potash and soda).	
	Solid.	Liquid.	Solid.	Liquid.	Solid.	Liquid.	Solid.	Liquid.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Horses	76	89.0	0.50	1.20	0.35	Trace.	0.30	1.5
Cows	84	92.0	0.30	0.80	0.25	Trace.	0.10	1.4
Swine	80	97.5	0.60	0.30	0.45	0.125	0.50	0.2
Sheep	58	86.5	0.75	1.40	0.60	0.050	0.30	2.0

The urine is seen to be much richer than the solid dung in every case except that of pigs, in which the high percentage of water (97.5) causes the percentages of the other constituents to fall below those of the same constituents in the solid dung.

The fact that the urine of all farm animals (including pigs) is much richer than the solid excrement is strikingly brought out in the following table, which shows the composition of the dung and urine after the water has been completely removed:

Composition of dry matter of solid and liquid manure.

	Nitrogen.		Phosphoric acid.		Alkalies (potash and soda).	
	Solid.	Liquid.	Solid.	Liquid.	Solid.	Liquid.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Horses	2.08	10.9	1.45	Trace.	1.25	13.6
Cows	1.87	10.0	1.56	Trace.	0.62	17.5
Swine	3.00	12.0	2.25	5.00	2.50	8.0
Sheep	1.78	10.4	1.42	0.37	0.71	14.9

The distribution of the manurial constituents in the urine and dung depends largely on the nature of the food. On this point Warington says:

If the food is nitrogenous and easily digested the nitrogen in the urine will greatly preponderate; if, on the other hand, the food is imperfectly digested the nitrogen in the solid excrement may form the larger quantity. When poor hay is given to horses the nitrogen in the solid excrement will exceed that contained in the urine. On the other hand corn, (oil) cake, and roots yield a large excess of nitrogen in the urine.

Generally one half and frequently much more of the total nitrogen excreted will be found in the urine, a large portion of the potash, but little or no phosphoric acid or lime. In experiments with sheep at the Maine Experiment Station it was found that "the urine contained nearly half the potash of the total excreta and from half to three fourths of the nitrogen, but no phosphoric acid, the latter being wholly in the solid excrement."

The important points in this connection may be summarized as follows:

(1) Of the nitrogen, phosphoric acid, and potash supplied in the food, comparatively small amounts are assimilated and retained in the animal body, the relation between the amounts of these substances excreted in the urine and the solid excrement depending largely upon the nature of the food.

(2) The urine is much richer in nitrogen than the solid dung. It also contains considerable amounts of potash but is poor in phosphoric acid, which remains almost entirely in the solid excrement. The best results may therefore be expected from applying the mixed solid and liquid excrement.

LASTING OR CUMULATIVE EFFECT OF BARNYARD MANURE.

Barnyard manure is probably the most efficient means at the disposal of the farmer to permanently improve his soil. No other fertilizer possesses to so great a degree the power of restoring worn soils to productiveness and giving them lasting fertility. It accomplishes this result, however, not so much by the actual fertilizing constituents which it supplies as by improving the *physical properties of the soil*, increasing the amount of *humus*, which is generally *deficient in worn soils, improving its texture*, and increasing its *water-absorbing* and *water-holding power*. Experiments have shown that the influence of manure may be perceptible twenty years after application.

SUMMARY.

(1) Barnyard manure is the most important manurial resource of the farm and should be carefully saved and used. It represents fertility drawn from the soil and must be returned to it if productiveness is to be maintained. In many cases it has been demonstrated that the value of the manure obtained in cattle feeding represents largely, if not entirely, the profit of feeding.

(2) There are sound scientific reasons for the high esteem in which this manure is held. It contains all the fertilizing elements required by plants in forms that insure plentiful crops and permanent fertility to the soil. It not only enriches the soil with the nitrogen, phosphoric acid, and potash which it contains, but it also renders the stored-up materials of the soil more available, improves the mechanical condition of the soil, makes it warmer, and enables it to retain more moisture or to draw it up from below.

(3) The amount and value of manure produced by different kinds of farm animals may be judged from the following figures, calculated to 1,000 pounds of live weight: Sheep, 34.1 pounds of manure per day, worth 7.2 cents;

TROLLEY LINE THROUGH THE WHEAT FIELDS. Yield of Wheat, 40 Bushels Per Acre. Property of Mr. Compton, Roanoke County.

calves, 67.8 pounds, worth 6.7 cents; pigs, 83.6 pounds, worth 16.7 cents; cows, 74.1 pounds, worth 8 cents, and horses 48.8 pounds, worth 7.6 cents, basing calculations of value on market prices of commercial fertilizers, which probably gives results much too high. Making liberal allowances for these and other considerations, Prof. Roberts estimates that the value of the manure produced on a small farm carrying 4 horses, 20 cows, 50 sheep, and 10 pigs during the seven winter months amounts to about $250.

(4) The urine is by far the most valuable part of the excreta of animals. It is especially rich in readily available nitrogen, which rapidly escapes into the air if special precautions are not taken to prevent its loss. It is also rich in potash, but deficient in phosphoric acid. It should, as a rule, be used in connection with the solid dung, the one thus supplying the deficiences of the other and making a more evenly balanced manure.

(5) Barnyard manure is a very variable substance. The more important conditions which determine its composition and value are (1) age and kind of animal, (2) quantity and quality of food, (3) proportion of litter, and (4) method of management and age. Mixed barnyard manure properly cared for may be assumed to have the following composition: Water, 75 per cent; nitrogen, 0.57 per cent; phosphoric acid 0.3 per cent; potash, 0.57 per cent.

(6) Mature animals, neither gaining nor losing weight, excrete practically all the fertilizing constituents consumed in the food. Growing animals and milch cows excrete from 50 to 75 per cent of the fertilizing constituents of the food; fattening or working animals from 90 to 95 per cent. As regards the fertilizing value of equal weights of manure in its normal condition, farm animals probably stand in the following order: Poultry, sheep, pigs, horses, cows.

(7) In a given class of animals the value of the manure is determined more by the nature of the food than by any other factor. The amounts of fertilizing constituents in the manure stand in direct relation to those in the food. As regards the value of manure produced the concentrated feeding stuffs, such as meat scrap, cotton-seed meal, linseed meal, and wheat bran stand first, the leguminous plants (clover peas, etc.) second, the grasses third, cereals (oats, corn, etc.) fourth, and root crops such as turnips, beets, and mangel-wurzels last.

The nitrogen of the food exerts greater a greater influence on the quality of the manure than any other constituent. It is the most costly fertilizing constituent, and is present in largest quantity. It undergoes more modification in the animal stomach than the mineral constituents (potash and phosphoric acid), and rapidly escapes from the manure in fermentation. The secretion of urine increases with the increase of nitrogenous substances in the food, thus necessitating the use of larger amounts of litter and affecting both the amount and value of the manure. The use of watery foods, as is obvious, produces the same result.

(8) The deterioration of manure results from two chief causes, (*a*) fermentation, whereby nitrogen, either as ammonia or in the gaseous state, is set free, and (*b*) weathering or leaching, which involves a loss of the soluble fertilizing constituents. The loss from destructive fermentation may be almost entirely prevented by the use of proper absorbents and preservatives, such as gypsum, superphosphate, and kainit, and by keeping the manure moist and

compact. Loss from leaching may be prevented by storage under cover or in pits. Extremes of moisture and temperature are to be avoided, and uniform and moderate fermentation is the object to be sought. To this end it is advisable to mix the manure from the different animals thoroughly in the heap.

(9) When practicable it is best to apply manure in the fresh condition. The disposition to be made of the manure of the farm (both fermented and unfermented) must be determined largely by the nature of the crop and soil. Where improvement of the mechanical condition of the soil is the principal object sought, fresh manure is best adapted for this purpose to heavy soils and well-rotted manure to light soils. Where prompt action of the fertilizing constituents is desired, the best results will probably be obtained by applying fresh manure to the light soils, although excessive applications in this case should be avoided on account of the danger of "burning out" of the soil in dry seasons. Fresh manure has a forcing effect, and it is better suited to grasses and forage plants than to plants grown for seed, such as cereals. Direct application to root crops, such as sugar beets, potatoes, or tobacco, often prove injurious. The manure should be spread when carried to the field, and not left in heaps to leach.

The rate of application must be determined by individual circumstances. As a rule it is better to manure lightly and frequently than to apply a large amount at longer intervals.

(10) One of the best ways to utilize barnyard manure is to combine it with such materials as supplement and conserve its fertilizing constituents. The best results are likely to be obtained by using commercial fertilizing materials in connection with barnyard manure, either in compost or separately. As is well known, barnyard manure is lasting in its effects, and in many cases need not be applied so frequently as the more soluble and quick-acting superphosphates, potash and nitrogen salt, etc.—*U. S. Farmers' Bulletin.*

The Care of Pastures.

Pastures are short at the close of summer. The season's grazing has eaten them down close, and this is the rest period for blue-grass. Stock is subject to more shrink during the month of August, with its heat, its fly pest and its short grass than during any other "out-door" month, and little effort is made by farmers to prevent it. The American farmer, as a class, has yet to learn the value of feeding his pastures as he feeds his fields. For some inexplicable reason he seems to imagine that grass needs no manure, that it is the business of grass to grow and keep on growing, no matter how severely it is grazed. And when it does fail he lets the cattle kick up the dust in a vain and shrinking search for nourishment. Manure will pay as well on pasture lands as on plowed fields. The introduction of the manure spreader affords an easy method of application and it puts it on in a way that cannot be done by hand. Pastures lightly top-dressed will not burn out. As fast as a spot is grazed bare as the season advances it should be top-dressed, whereupon the stock will cease gnawing it into the

IT PAYS TO HELP THE CATTLE WHEN THE PASTURE IS SHORT.

ground and seek other grazing. With the appearance of the late summer or fall rains the grass will quickly spring up in the top-dressed parts, growing with a vigor and luxuriance that will astonish the farmer and afford hearty sustenance for stock during the fall and winter.

It is singular that manure for top-dressing pastures is almost an unknown art in modern farming. Some farmers fear that manure will "ruin" the grass so that stock will not eat it. It is a pity that our pastures have not been thus "ruined" for years past; the farmer would be richer than he is if he had followed that course of farming. It is true that droppings in pasture, unless scattered by fowls or washed away by rains, will kill out the grass under them, and that stock does not relish the rank growth that comes at the edges of such spots. But that is altogether different from a light dressing of barnyard fertilizer evenly distributed over the grass by the manure spreader. Knolls and other spots in the pasture that are early eaten into the ground by grazing stock should be immediately protected by a light coat of manure and the efficiency of the pasture greatly enhanced thereby. It is very much of a question if cattle can be pastured economically on high-priced lands where chronic neglect of the grazing lands characterizes the farm practice. The plow and the summer silo will undeniably make much more available feed and under some circumstances will furnish provender at a greater profit than the neglected pasture.

One of the most exasperating sights in American agriculture is a herd of cattle fighting flies in a bare pasture, raising the dust at every stamp of the foot, roaming from fence to fence in vain search for grass, and meanwhile losing in milk and flesh at every moment, while just beyond the fence stands a field of corn, rank in its luxuriance and fairly black in its greenness. On the one side of the fence is poverty, on the other opulence. And the farmer is too nearsighted to supplement the poverty of his pastures from the opulence of his cornfield. It is the most singular blindness to the laws of economics as well as nutrition. Get into that field with the corn knife or corn harvester. Throw the succulent provender over the fence and let the cattle eat. It is worth more now to them than it will be in the shock and in the crib. Use the food that nature has provided. Do not try to save at the spigot and waste at the bung.—*Breeder's Gazette.*

Red Clover Mixed with Alsike Clover.

It has been noticed that many of the farmers in portions of Pennsylvania where it is difficult to grow red clover any more, are mixing alsike clover with the red clover, with very good results; the alsike seems to outgrow the red on the dry, hilly lands there. Alsike clover will grow where the land has less humus and more acid, and lasts longer than red clover. It is a good soil improver. If sown alone, four pounds per acre is sufficient, but if mixed with red clover, less should be used. This mixture is being grown now in western Pennsylvania on all kinds of soils, and is well worth trying in Virginia.

Wheat Breeding.

This wheat originated at Fincastle, Botetourt county, in the year 1904. The original plant had its origin from a single grain. It produced 142 straws on stems, each of which formed a head, and each head formed grains; 67 of the heads matured their grains and the remaining 75 contained immature grains. The plant was badly rusted, due (I think) to its having been closely wrapped in netting, which was done to protect it

One Grain of Wheat Produced 142 Stems.

from sparrows, whose attacks were so persistent that it was necessary to cover not only the sides of the plant, but across its top as well. No fertilizer was used, and nothing whatever, either by cultivation or otherwise, was done to stimulate the plant. The wheat is bearded white chapp, with medium size grains, red and very hard.

It grows from four and a half to five feet tall. The straw is large,

Plot of Wheat Breeding by Mr. K. B. Stoner, Botetourt County. One Original Grain Produced 142 Stems, Bearing Heads of Wheat.

resembling rye more than wheat, and is strong and hard. The straws on stems from the stools first grow outward rather than upward, and some of the stools have measured sixteen (16) inches across.

The summer of 1904, in our section of the State, was wet, and followed by a fall drought. In September, 1904, I broke with a turning plow a small strip of heavy clay land, bordered on the one side by a blue-grass sward. The land had been cultivated to corn and tomatoes; there was no rain, and it was impossible to put it in proper order. On this strip, on the 18th of October, 1904, I sowed 2,338 of the 2,500 mature grains taken from the original stock or plant of wheat. Of these only 1,842 grains came up, and some of them not until the first week in December. No fertilizer was used. This first sowing under the circumstances as stated, gave a product equivalent to an hundred bushels to the acre.

The second sowing—the present one, fall of 1905—was made under favorable conditions. The land in good order, wheat sown at proper time, season so far excellent, and (I think) the stooling far better than it was last year, and it now seems there is every reason to believe that the next harvest will furnish a fair test of whether or not this wheat will continue to produce what we claim it has produced—at the rate of one hundred bushels per acre. In the effort to give it full opportunity to do its best, we have sown the product of the 1,842 grains in several ways—have sown an acre by drill, have sown broadcast both light and heavy, have sown with and without fertilizer, and have sown in hand drills at different distances in our experimental way.

Very respectfully,

K. B. STONER.

The Preparation of Tobacco Seed.

By A. D. SHAMEL, *of the Bureau of Plant Industry, U. S. Department of Agriculture, in Co-operation With the Connecticut Agricultural Station, New Haven.*

It has been proved by exact experiment, regarding many kinds of agricultural seeds, that the seed which is heaviest (not necessarily the largest or having the greatest specific gravity) produces more vigorous and productive plants than lighter seed.

This is partly because the heavy seed has the most perfect embryo or plantlet in it, and the largest supply of available plant food to support the seedling until it has developed roots and leaves so as to feed itself.

One of the causes of freak tobacco plants, that is, such as top out prematurely or differ in shape and quality of leaf from the bulk of the crop, is the sowing of small and light seed. In a series of extensive experiments in the Connecticut valley, the writer separated samples of seed of the varieties grown in this region, into light, medium and heavy grades. In all cases the small and light seed produced the earliest plants in the seed bed, and these plants when set in the field developed a large percentage of undesirable plants, which are almost a total loss to the grower.

In crops like oats or wheat, if some of the seed fails or produces poor plants, the rest of the plants stool out, and to some extent mitigate the effect of the use of the poor seed. In the tobacco crop, however, there is no compensation of this kind. The sound plants grow no better because others are inferior or unthrifty and the inferior plants, mixed with the others, damage the market value of the whole.

Dr. L. Trabut and other foreign experimenters have proved that the plants grown from light seed produce not only a very small yield, but the tobacco is of a very inferior quality. The light and the small tobacco seed can be removed by the grower, now, before the seed is sowed in the seed bed, without any extra cost. The increase in yield and improvement in quality of the crop secured by this attention to the seed, is pure profit. It costs no more to cultivate and grow a uniform crop of tobacco than a crop with a large proportion of poor plants. Therefore, it is extremely important that the tobacco growers separate out the light and small seed before sowing the seed beds.

Many of the light and inferior seeds are of the same size as the heavy and desirable seed, and the difference generally between large and small seed is slight, so that it is not possible to separate the desirable from the undesirable seed by screening with any kind of sieves.

Some recommend water separation for lack of a better method. The seed is thrown into a vessel of water, and when the heaviest seed have sunk to the bottom the light seed are skimmed off. This plan is not a success, because the bubbles of air in the water prevent much of the heavy seed from sinking, and the separation is thoroughly unsatisfactory. Other methods have been recommended, but there are none so simple and practicable as the use of the current of air. A complete separation of the light and small from the heavy seed can be made by constructing a machine similar to one designed and used by the writer.

This seed separator consists of a glass tube one inch in diameter and five feet long, and a glass receptacle for holding the seed, having the diameter of the long glass tube, and so arranged with a finely woven wire screen in the bottom as to hold the seed in the receptacle and at the same time freely admit a current of air directly into the seed. The top of this receptacle is fitted with a coupling into which the long glass tube can be set and held in place. The current of air is generated by a common foot-bellows, and regulated with a valve.

The seed to be separated is poured into the receptacle, usually about one to two ounces at a time, the glass tube set in place, and a current of air pumped into the seed. The lightest seed and the chaff are first blown out of the tube, and next the small seed. Small seeds of the same character as the larger seeds have proportionally more surface than the larger, consequently the small as well as the light seed is removed by this machine.

No doubt great improvements will be made in the machines for this purpose. Already Mr. D. P. Cooley, of Granby, Conn., who is co-operating with us in the improvement of Havana seed tobacco by breeding and seed selection, has designed a machine which is simple and practical. Mr. Cooley has separated several bushels of seed in the last few weeks, and it has been found in these tests that a lot of the seed saved last fall, and thought to be

sound, was partially injured by frost and should not be used for seed under any circumstances.

Heavy seed produces large, healthy, uniform and well-developed plants. The seed separated in the Connecticut valley this season shows that the seed that will be used for sowing consists of about one-half of light, undesirable seed. If this seed is separated out and only the heavy seed used for sowing, it will mean the addition of thousands of dollars to the value of the coming crop. There is no grower who can afford to grow weak, variable, freak plants from light seed, when a little time, with no other expense, will enable him to get rid of a large proportion of these undesirable plants. There are about 500,000 tobacco seeds in an ounce. The enormous quantities of seed used to sow the seed beds is sufficient evidence that a large proportion of the seed used is poor in vitality and quality. This poor seed can easily and practically be gotten rid of by using a seed separator.

A large number of growers have already separated their tobacco seed this season, and tested the vitality of the heavy seed. In every case reported so far, the growers have found that the heavy seed has sprouted exceptionally well, and they are surprised and thoroughly satisfied with the results of the seed separation.

A thin sowing of heavy seed in the bed will no doubt yield as many or more sound plants than the usual sowing of unseparated seed.

Separate the seed. Grow this year's crop from the heaviest and best seed which you have.

[Tobacco grown from the best seed is less liable to disease, such as mosaic or wilt or frog-eye. The importance of seed selection applies to all kinds of tobacco.]

The Selection of Tobacco Seed Plants.

By A. D. SHAMEL, *of the Bureau of Plant Industry, U. S. Department of Agriculture, in Co-operation with the Connecticut Agricultural Experiment Station, New Haven.*

Every grower is familiar with the fact that no two tobacco plants are alike. Frequently the grower finds a plant in the field that almost or quite fulfils his ideal of a perfect plant. It would be very desirable to produce uniform crops of the type of these best plants, because they would be much more productive and of better quality. As a result of the investigations which have been carried on in the Connecticut valley and elsewhere it has been found that it is possible for every grower to select the type of plant he desires to grow as seed plants, and by protecting the flowers produced by these plants from cross-fertilization, to secure uniform types or strains like the parent seed plants. This important improvement can be made by the grower in a simple and practical manner, as described in the following article, without any extra expense and with very little trouble or work. In view of the fact that any improvement in the yield or quality of the crop secured by seed selection is pure profit, because it costs no more to grow good

plants than poor ones, there is no farmer who can afford to grow a poor type of tobacco when it is possible to produce improved strains.

POSSIBILITY OF IMPROVING THE QUALITY OF TOBACCO.

There is no lack of either practical experience or experimental evidence to prove that improved strains of tobacco may be produced by systematic seed selection and breeding. In the Connecticut valley there are many strains of the broadleaf or seed leaf variety, which are adapted to certain market requirements, or local soil and climatic conditions. The broadleaf variety is commonly believed to have been produced from the Maryland smoking tobacco variety, the seed of which was brought into the valley over a half century ago. The local strains as the Halliday, the Willow brook, and many others were produced by certain growers who selected a particular type of seed plant that suited their fancy for several years in the usual manner until the type became fairly uniform and constant. The popular Havana seed variety is reported to have been produced from seed originally imported from Cuba, and grown in Connecticut for a number of years in small patches, until the variety had become adapted to the soil and climatic conditions of this section. There are at present a number of strains of this variety, distinguished by peculiar shape of leaves or other characteristics, which have been secured by many years of careful seed selection by the growers. One of the most striking illustrations of the possibilities of seed selection is the origin of the White Burley variety. This variety, as is well known, was produced by a grower in Southern Ohio, who noticed in his field of Red Burley these plants having the peculiarities of the now well-known White Burley type, and saved them for seed. From this beginning a great industry has been developed in Southern Ohio, in Kentucky and other States. Numberless other illustrations might be cited in this connection, but on account of the fact that they are well known to almost every grower, and are matters of history, it is unnecessary to further comment on the work that has been done in order to prove the fact that it is possible to greatly modify and improve this crop by an application of the laws of plant breeding.

In the season of 1903 the writer began a series of experiments in the Connecticut valley with tobacco in order to determine the possibilities of improvement by the application of the laws of plant breeding, as worked out in the cases of corn, cotton and other farm crops, and to find the methods by which this improvement could most rapidly be effected. It is not opportune in this short bulletin to go into details as to the results of the experiments in that and the succeeding season, which will be presented in a later and more extended bulletin, but the general results will be briefly discussed here and the practical results and methods presented for the help of the growers for this season. This matter is not theoretical or impractical and of scientific interest only, but it is intensel practical and can be applied by every grower of tobacco to the advantage of his crop, and with increased profits in his business.

LACK OF UNIFORMITY OF PLANTS IN THE AVERAGE TOBACCO CROP.

The extent of the variation or lack of uniformity among plants in fields of tobacco in the Connecticut valley is best illustrated in the crops grown

from seed originally imported from Sumatra and Cuba, but grown in Connecticut for several years. In a careful and systematic study of such crops by the writer, it was found that the difference in plants was so great that it was possible to separate out and classify several distinct types. The differences between these types were just as marked as the distinguishing characteristics of the broadleaf and the Havana seed varieties. These variations were not due to local soil or fertilizer conditions, as generally supposed, but to the seed, as shown by the fact that they occurred in all parts of the fields investigated, in many cases two plants of radically different types growing side by side under as nearly uniform conditions as is ever secured. The type characteristics were very marked, and easily distinguished, even by the most casual observer. In one of the types of Connecticut Sumatra the leaf was very long, narrow, heavy, with peculiar angular veins, unusual light greenish gray color, and of very peculiar and characteristic habit of growth. From its fancied resemblance to the so-called Belgian tobacco, it was called and is recorded as the Belgian type. Another of the types produced nicely rounded leaves, from eighteen to thirty on every plant, with very peculiar wavy or crumpled edges, comparable in many ways to the crumpled leaves of some varieties of lettuce. The leaves of this type were very thin and in most cases lacked strength and elasticity, so that when wrapped on cigars a considerable percentage was likely to break or be injured in some manner. From the characteristic wavy margin of the leaves these plants of tobacco were classified as the crumpled type. Another type found in these crops, called the Sumatra, produced leaves that were nearly round and were borne in a drooping position on the stalks. This type of leaf in the field was pronounced by one of the extensive growers as ideal for cigar wrapper purposes, so far as the shape of leaf and other qualities that can be determined in the field were concerned. The leaves had good body, and extremely regular and fine veins, which stood out almost at right angles with the mid ribs. One of the most striking types produced very large leaves, in many cases larger than the largest strains of the broadleaf variety, and a characteristically large number of them. While the growth of the plants was very slow in the first part of the season, they produced ripe tobacco as soon as the early maturing types. The rate of growth of the plants of this type in twenty-four hours. at the middle of the season, was nearly double that of corn at the most favorable time for rapid growth. Another type produced characteristically small leaves, called the greenleaf type, because of the deep shade of green color of the leaves. The average length of the leaves of this type was not more than one-quarter the average length of the leaves of the broadleaf type. The leaves were very uniform in size as well as shape from the top to the bottom of the plants. The number of leaves per plant was very large, in many cases plants producing forty desirable leaves. This increase in number of leaves in this type was not accompanied by a corresponding increase in the height of the plants, but was correlated with short internodes or spaces between the leaves on the stalk.

In all of the crops grown from freshly imported seed there appeared a large proportion of abnormally early, small, heavy leaved types, commonly called freaks. These plants had in most cases the branching habit of the wild or unimproved varieties of tobacco, and for this and other well-founded

reasons were supposed to be reversions to some of the unimproved varieties from which the present varieties have been developed. These freaks were particularly noticeable in the crops grown from freshly imported Cuban seed. In one typical field of this kind the writer found 33 per cent. of the plants to be of this freak type. Inasmuch as the leaves produced by the freak plants are almost wholly worthless for wrapper purposes, it can readily be seen that such crops are not profitable to the growers. After a most careful study of this subject it can be safely said that in no case should growers depend on freshly imported seed for their main crops of tobacco. If it is desirable for the grower to test foreign, imported or new seed of any kind, it should be done on a small scale until it is determined that the variety is adapted to local soil and climatic conditions, or acclimated strains are produced by seed selection and breeding.

The variation *in type* in the broadleaf, Havana seed and other so-called native varieties is not so marked as in the case of varieties grown from recently imported seed. *The individual variation* or differences between different plants as regards the number, shape, and size of leaves, the number of suckers, the number of seed pods and other characters are nearly as great as among plants grown from imported seed. In every field examined some plants were found with nearly double the number of leaves found on the average plants in the field. Many plants produce rounded leaves, while others bear long, narrow and pointed leaves. Some plants have a large number of suckers, while others have comparatively few of them. Some plants produce from one hundred and fifty to two hundred seed pods, while others bear from twenty-five to one hundred pods. In many instances the writer has found plants that produce ripened leaves two weeks earlier than the remainder of the crop. Many plants produce leaves that ripen uniformly from the top to the bottom of the plants, while others produce bottom leaves and lower leaves that ripen from ten days to two weeks before the upper or top leaves are ready to harvest. Some plants produce leaves with large and coarse veins, while others in the same field bear leaves with fine and small veins. Individual plants were found in all fields bearing leaves having more desirable body, stretch or elasticity, color or appearance, and other characteristics, than the other plants in the same field. In fact, the tobacco crops present the greatest amount of variation in type and individual characteristics of any farm crop known to the writer. The large number of grades of color, sizes, and qualities of leaves, which the growers find necessary to assort after the tobacco is cured or fermented, is definite evidence of the lack of uniformity in this crop. This lack of uniformity in the crop is detrimental to its value, not only because some of the grades are poor and of very little value, but also on account of the cost of assorting these variations into their respective grades.

Increase in the uniformity of the tobacco crop means increased yield and a more valuable crop. Inasmuch as it costs as much, if not more, to grow a crop lacking in uniformity, as to grow a uniform crop of desirable plants, this increase in value is pure profit to the grower. The methods of seed selection and breeding presented in this bulletin have been found both experimentally and in farm practice to produce more uniform crops of tobacco, with no extra expense to the grower.

SELF-FERTILIZATION AND CROSS-FERTILIZATION OF TOBACCO.

In order to present the methods of seed selection and breeding, it is necessary to refer to the tobacco flowers and the natural method of fertilization in tobacco plants. The tobacco flower consists of a brightly colored tube-like corolla, enclosing five, more or less, stamens, *i. e.*, slender filaments bearing at their ends plump bodies, called anthers, in shape somewhat resembling a cigar. When the flower is just about to open, these anthers contain a large amount of fine dust-like particles, the pollen grains, or the male fertilizing element of the flower. At the base of the flower is a small pod-like receptacle, which later forms the seed pod and which bears a long, slender, rod-like projection, having a knob-like swelling at the tip, the whole being called the pistil. This knob-like portion is the receptive part of the female portion, or stigma of the flower, on which the pollen falls which fertilizes the flower. In the early stage of the development of the flower this stigma projects above the cluster of anthers, but later the anthers gradually grow past it, at the same time opening and discharging the pollen so that it falls on and fertilizes the stigma. At this time the stigma will be found to be covered with a sticky substance to which the pollen adheres. Gradually the anthers push out of the opened flower and project beyond the stigma. At the base of the tube-like corolla will be found a secretion of sweetish honey-like substance, which can be shaken out of the flowers and falls like drops of rain on the plant. Many species of bees and other small insects crawl down into the opened flowers and feed upon this honey-like substance. The writer has observed humming birds feeding on this honey, similar to the manner in which they visit the flowers of the common honeysuckle. In passing to and from these flowers they naturally carry the pollen from flower to flower, and from plant to plant and rub it off on the stigmas, and in this way effect "cross-fertilization" among the plants in the field. Cross-fertilization must be very general among tobacco seed plants in the field under the ordinary conditions.

A flower is "self-fertilized" when the seeds are produced by the impregnation or fertilization of its pistil by pollen from its own stamens. It is "cross-fertilized" when seeds are produced by impregnation with pollen from another plant. In some species of plants cross-fertilization is absolutely essential to seed production. In other species it produces more and better seed than self-fertilization. But tobacco belongs to still another class of plants which are abundantly self-fertile and in which self-fertilization is apparently more effective for seed production than cross-fertilization.

Charles Darwin found in greenhouse experiments that "in six trials with crossed and self-fertilized (tobacco) plants, belonging to three successive generations, in one alone did the crossed show any marked superiority in height over the self-fertilized; in four of the trials they were approximately equal; and in one *i. e.*, in the first generation) the self-fertilized plants were greatly superior to the crossed. In no case did the capsules from flowers fertilized with pollen from a distinct plant yield many more and sometimes they yielded much fewer seeds than the capsules from self-fertilized flowers."

ADVANTAGES OF USING SEED FROM SELF-FERTILIZED FLOWERS.

In the last two years extensive experiments have been made in the Connecticut valley on the relative value of seed produced by exclusive self-fertilization and of seed produced by natural cross-fertilization. These experiments have been made with the Connecticut Havana, Broadleaf, Sumatra and Cuban types of tobacco, under cloth and in the open, and on a commercial scale; in all cases with like results. These results we consider are of the very greatest importance to growers and are here very briefly summarized.

Seed produced by exclusive self-fertilization for the two generations covered by our observations has been lighter in color, heavier, freer from mold or fungous disease, and in all ways more valuable, as will appear in what follows.

The plants grown from self-fertilized seed reproduced exactly the character of the mother plant from which they came. *If the parent had large leaves, so did all the progeny; if the parent had small leaves, so did all the progeny; and in both cases the average size was the same as the average size of the parent's leaves.* The uniformity in size of the plants as well in the shape, size, veining and number of leaves is very striking.

Plants from a parent with few suckers had correspondingly few suckers. The shape of the leaves of the offspring was closely like the shape of the parent's leaves.

The same correspondence appeared in the number of leaves. If the parent had thirty-five leaves, the offspring averaged about thirty-five leaves. If the parent bore ten, the offspring averaged ten.

In a word, the individual characters, such as shape and color of leaves, numbers of leaves and suckers, body or texture, size of veins, time of maturity, and all other observed characters were transmitted from the parent seed plants to their offspring with marvelous uniformity.

Two particular experiments emphasize this accurate transmission of individual characters by the seed of self-fertilized flowers.

In a field of Connecticut Sumatra several hundred parent plants of different types were selected and the seed saved under bag; hence it was exclusively from self-fertilization. The progeny of these plants were set out in separate rows in the same field, under as uniform conditions as it is possible to secure, the following season. One of these types produced leaves which would not burn, even with all of the tests that were applied. Growing side by side with this type, in several parts of the field, was another type, which, tested in the same ways, had the most perfect burn of any kind of tobacco grown in any part of the world. Here were two types, from the same original lot of seed, the parents grown in the same field, the progeny grown under as uniform condition as is ever secured in the field, the tobacco cured and fermented absolutely alike, one of which would not burn, and the other burned perfectly.

One more instance is presented because of its specially interesting nature and importance. A field was set out with plants grown from imported seed, which were attacked by a fungous root disease, and all died with the exception of a few plants. These resistant or immune plants were found irregularly over the field, and produced ripe tobacco of excellent quality. All the other plants were completely destroyed with the exception of one or two

semi-resistant plants that produced a large amount of seed, but very few and extremely small leaves. The seed was saved separately from the resistant and semi-resistant plants, and sowed in separate sections of the seed beds. The resistant seed produced perfectly resistant plants, both in the seed bed and in the field where the plants were destroyed the previous year.

Most of the seedlings from the semi-resistant seed died in the seed bed, but enough were finally secured to set out one or two rows in the field. These plants grew slowly, some died, and none reached maturity, all having the characteristics of the diseased plants in root, stalk and leaves. Some of the resistant seed was sowed on the seed beds where the diseased seedlings had been destroyed by the disease, and this immune seed produced perfectly resistant plants under these circumstances.

These extensive observations and experiments show that the transmitting power, as defined by Dr. H. J. Webber, or the "prepotency" of the seed of tobacco from self-fertilized flowers is wonderful, and we believe of very great practical importance. With an understanding of its value, with keen observation of the characters of individual tobacco plants which it is desirable to retain and reproduce, and with very little labor, the grower can modify, change and improve his strain of tobacco and can produce crops which are uniform in all respects and like the parent plants which he selects for self-fertilized seed production.

METHOD OF SELECTING PLANTS AND SECURING SELF-FERTILIZATION.

We may now briefly describe how this is to be done. In the first place, the field from which the selections of seed plants are to be made should be gone over carefully before the plants are topped, and the plants which come nearest the ideal of the grower should be selected for seed plants. This selection can be made at any time before topping, during the cultivation of the field as well as by special visits for this purpose, and during the topping process. The grower should, at these times, carry a handful of tags in his pocket and tie one on each of the plants which suits his fancy. No good selections are ever made, or permanent progress accomplished, by hit or miss and careless methods. The seed heads of the selected seed plants must be covered before any of the flowers open in order to prevent any possible cross-fertilization. If, by accident, some flowers have opened before the seed heads are bagged, they should be carefully picked off and thrown away. It is a good plan to pick off all of the top leaves down to where the plant would have been topped if it had not been saved for seed. All of the large lower seed branches should be broken off, and only the central cluster of seed-bearing branches left for seed purposes. As a rule, each mature pod contains from three to seven thousand seed, so it can be readily seen that a few pods will produce a large amount of seed. Of course, the grower should save many times the amount of seed that he expects to use.

The common manila twelve-pound grocery bag, procurable at any good grocery, hardware, or general store, is admirably suited for this purpose. The bag with a roof-shaped bottom is better than the square-bottom shape because it sheds the rain better. The bag should be carefully fitted over the seed head, and the open end tied around the stalk below the seed head, not

so tightly as to injure the plant, or so loosely as to allow the bag to be slipped or blown off by the wind, or allow the visits of insects which might crawl up the stem inside the bag. Adjustment of the bag is shown in the cut.

As the plant grows in height, the bag should be moved up the plant so as

Tobacco Plant Selected for Seed.

to accommodate the extra growth and prevent the seed head from pressing against the bottom of the bag, which might injure or break off the flowers and seed pods. Late in the season, after all or most of the pods have set, the bags should be opened and all of the loose flowers and other debris shaken out, after which it should be immediately retied and allowed to remain in this condition until the pods have turned brown, indicating maturity. Some growers advocate picking off the leaves from the seed plants as they ripen, while others allow them to remain until the seed heads are harvested. If the suckers are carefully kept removed, it will be perfectly safe to allow the leaves to remain on the seed plants. On the other hand, if it is desirable to save the leaves, they can be picked off as they ripen without injury to the seed.

We would advise those who wish to make the most careful selection and who have the facilities for it, to pick the leaves from the separate seed plants, when they are ripe, cure them as usual in the barn with the rest of the crop, keeping the leaves of each plant by themselves, suitably labeled. If opportunity offers, let them be fermented with other tobacco during the winter. They can then be judged quite fairly as to burn, colors and texture, and the seed of the very best of them saved for the following crops.

When the pods are mature, the seed heads, bags, and all, should be cut off, and hung up in a dry, airy place, where they can thoroughly dry out with a free circulation of air. After drying it is a good plan to keep them where the temperature does not fall much below zero. In the spring when the time comes for the preparation of the seed for sowing, the largest and best pods should be picked off by hand, and thoroughly threshed out to remove all seed. The seed should then be separated with the seed separator in the way described in Bulletin 149 of this Station.

[The value of seed selection applies to all kinds of tobacco, both chewing as well as smoking.]

Experiments with Fertilizers Upon the Yield of Timothy Hay.

There is no crop that pays as well as the hay crop, and it is a great mistake in the farmers not to sow enough of the hay grasses and the legumes to have an abundant supply of good hay and forage for home use and also to sell in the spring at good prices. No farmer can afford not to sow every year some nitrogen gathering crop in a regular rotation. The following experiment shows the economic use of fertilizers as to the proportion of the different fertilizer ingredients to give the highest yield and profit:

714
No treatment.
2400 lbs. hay per a.

713
80 lbs. Muriate Potash.
3190 lbs. hay per a.

712
320 lbs. Acid Phosphate.
2680 lbs. hay per a.

The growth upon these plats was rather short and of fine texture. Considerable alsike clover grew on plat 713.

723	722	721
No treatment. 3200 lbs. hay per a.	160 lbs. Nitrate Soda. 80 lbs. Muriate Potash. 640 lbs. Acid Phosphate. 4350 lbs. hay per a.	160 lbs. Nitrate Soda. 80 lbs. Muriate Potash. 320 lbs. Acid Phosphate. 4590 lbs. hay per a.

Both the yield produced as well as the cost of applying will be effected by the proportion of the ingredients of a fertilizer mixture. Observe the data for plat 721, 722 and 725 on the influence of proportion of Nitrate of Soda and Acid Phosphate.

727	726	725
160 lbs. Nitrate Soda. 80 lbs. Muriate Potash. 320 lbs. Acid Phosphate. 4310 lbs. hay per a.	No treatment. 2110 lbs. hay per a.	320 lbs. Nitrate Soda. 80 lbs. Muriate Potash. 320 lbs. Acid Phosphate. 6610 lbs. hay per a.

INFLUENCE OF FERTILIZERS UPON THE YIELD OF TIMOTHY HAY ON GOOD LAND.

Plat No.	Treatment.	Yield of hay per acre lb.	Increase in yield of hay lb.	Total value of increase.	Net gain or loss (-) from fertilizers.
711	No treatment	1,910			
712	320 lbs. Acid Phosphate	2,680	607	$3.21	$ 1.61
713	80 lbs. Muriate Potash	3,190	954	5.05	3.45
714	No treatment	2,400			
715	160 lbs. Nitrate of Soda	3,550	1,216	6.44	2.84
716	320 lbs. Acid Phosphate 160 lbs. Nitrate Soda	3,840	1,573	8.34	3.14
717	No treatment	2,200			
718	320 lbs. Acid Phosphate 80 lbs. Muriate Potash	2,800	510	2.70	—.50
719	160 lbs. Nitrate Soda 80 lbs. Muriate Potash	4,280	1,900	10.07	4.87
720	No treatment	2,470			
721	160 lbs. Nitrate Soda 50 lbs. Muriate Potash 320 lbs. Acid Phosphate	4,590	1,877	9.95	3.15
722	160 lbs. Nitrate Soda 80 lbs. Muriate Potash 640 lbs. Acid Phosphate	4,350	1,394	7.39	--1.01
723	No treatment	3,200			
724	320 lbs. Nitrate Soda 80 lbs. Muriate Potash 640 lbs. Acid Phosphate	5,880	3,044	16.13	4.13
725	320 lbs. Nitrate Soda 80 lbs. Muriate Potash 320 lbs. Acid Phosphate	6,610	4.137	21.93	11.53
726	No treatment	2,110			
727	160 lbs. Nitrate Soda 80 lbs. Muriate Potash 320 lbs. Acid Phosphate	4,310	2,380	12.61	5.81
728	160 lbs. "Niterlime" 80 lbs. Muriate Potash 320 lbs. Acid Phosphate	2,470	720	3.82	
729	No treatment	1,570			
730	No treatment	1,420			
731	10 tons of manure	4,090	2,595	13.75	13.75
732	20 tons of manure	5,520	4,025	21.33	21.33

It seems probable, moreover, that as the experiment continues the application of nitrate of soda or other readily soluble forms of nitrogen will become more profitable. The importance of this experiment, however, is in emphasizing the importance of systems of farm management which will bring to soils of this type in New York State the largest supply of readily available nitrogen. The use of leguminous crops and the proper preservation of stable manure, and particularly the liquid excrement, which contains the larger part of the nitrogen excreated by domestic animals is again emphasized.

No influence on the growth of timothy has been observed from the use of lime, but, in other experiments on the same soil type, marked results with lime have been obtained upon the growth of alfalfa.—*N. Y. Bulletin* 232.

Cowpea Hay.

Well-cured cowpea hay is a most valuable dry forage, ranking much above the common grass hays in feeding value and being at least equal in this respect to good clover and alfalfa hay. With the area of wild grasses decreasing from year to year in certain localities, and the tame grasses in many cases failing to produce adequate yields, a heavy yielding crop with a short period of growth, like some varieties of cowpeas, becomes an important source of hay. The principal reason why the production of cowpea hay is not commensurate with its high value is the difficulty in curing the large succulent vines. Experiments in growing cowpeas as a hay crop and in handling the same economically and successfully during the curing process have been made at the Alabama, Arkansas, and Mississippi experiment stations among others, and the results obtained are here briefly restated in the hope that the information may be of assistance in bringing into practice more effective and less costly methods of curing, and a consequent increase in the production of this kind of hay.

The Alabama Station sought to facilitate curing and to avoid the loss of the leaflets, a most nutritious portion of the plant, which readily break from the vines in curing and handling, by growing cowpeas in a mixture with some grass crop. The principal difficulty here lies in obtaining varieties which arrive at the proper stage for haymaking at the same time with the grass. On good soils German millet grown with the whip-poor-will cowpea proved useful in facilitating curing. The use of one peck of millet seed and one bushel of cowpeas per acre is recommended. If grown with a late variety, the millet will be ready for cutting while the cowpeas are still too immature to cure well and to make good hay. A test was made of planting Wonderful cowpeas, a late variety, and drilling millet to within six inches of the cowpea rows seventeen days later, but still the millet ripened before the cowpeas were ready for haying. While the millet did not add to the yield of hay, amber sorghum drilled with Wonderful cowpeas on May 14th gave a material increase in the yield, and was ready for mowing at the same time as the cowpeas. The hay of the sorghum mixture was more moist than that obtained from the millet mixtures, and therefore is likely to present greater difficulties in curing; and this will be especially so in unfavorable weather. With these results as a basis, the station recommends growing German millet as an aid in curing early varieties of cowpeas and Amber sorghum as a means of increasing the yield with later varieties.

As long exposure to sunshine causes the leaflets to drop off, curing should be accomplished with the smallest proportion of the mown crop exposed to direct sunshine. Curing is mainly influenced by the weather and the succulence of the vines, and hence the time required for the process varies with these factors. Based on the experience in curing cowpea hay for several seasons, the station suggests the following general course of procedure: "Cutting one day and twenty-four hours later raking into windrows, where the hay may remain twenty-four hours; then cocking and, if practicable, leaving

One Hundred and Sixty-Acre Field of Cow Pea Hay in Spotsylvania County. Mr. H. Wood

these cocks in the field for two or three days, at the end of which time they may be opened for a few hours before hauling, or hauled without opening, according to the condition of the hay." The use of canvas covers for the haycocks during wet weather was found to be very satisfactory, and is believed to pay for itself in the end. An experiment in storing half-cured cowpea hay in a tightly packed condition proved unsuccessful.

From several hundred plats under field conditions the Arkansas Station obtained during five years an average of 3,169.4 pounds of hay per acre. In general, the results did not include the weight of either peas or hulls. In one of the seasons the highest average yield of hay per acre, 8,750 pounds, was obtained from the Clay cowpea, and the lowest, 750 pounds, from New Era and Extra Early Black Eye, the yield of shelled peas from the three varieties being 174, 1,337.5, and 1,025 pounds per acre, respectively. A plat of Wonderful cowpeas yielded 8,350 pounds of hay per acre, and two plats of Clay 8,250 and 7,450 pounds, with practically no pea production. These great varietal variations in the capacity of producing either hay or peas very forcibly calls attention to the advantage of selecting varieties suitable to the purpose for which the crop is grown.

The results in curing the crops on these plats ranged from perfect success to complete failure. Young or vigorously growing vines were difficult to cure even under favorable weather conditions, while mature vines cured with little difficulty in favorable weather and usually made good hay after an exposure of two to four days of rain and cloudiness. The varieties producing few or no peas were most difficult to cure on account of their continued growth and succulent condition until checked by frost. Varieties producing the heaviest yields of peas were most easily cured into hay. Late shallow cultivation prolonged the period of growth, and in order to minimize the difficulties in curing it is suggested that if the crop is intended for hay, no further cultivation be given after the first pods are formed. Vines bearing a fair or full crop of peas well ripening together were easily cured when about one-fourth of the peas were ripe and no second growth took place, while if the peas ripened through a prolonged period, the plants continued in vigorous growth and were difficult to cure unless the weather was most favorable. Several varieties mown at different stages of growth to observe the effect of the degree of maturity on the curing of the vines for hay ripened their first pods as follows: Warren New Hybrid, August 15th; Warren Extra Early, August 20th; Whip-poor-will, August 28th; Taylor, September 8th, and Clay, September 14th. The first mowing, made when the varieties were forming their first pods, proved unsuccessful for haymaking. The second mowing, made when the first pods ripened, gave good hay from Warren New Hybrid and Warren Extra Early. The first and second mowings of Clay and Taylor were failures, but good hay was produced from Taylor mown when half or all of the pods were ripe. The number of days from sowing until the first ripe pods appeared was as follows: Warren New Hybrid, 67; Warren Extra Early, 72; Whip-poor-will, 80; Taylor, 90, and Clay, 97 days. Clay is a late grower and did not prove to be a very successful variety for hay.

In another comparison vines of New Era, Black Eye, and Warren Extra Early, after ripening a full crop of peas, cured into good hay ready for storage in two days, and Brown Eye, California Black Eye, Large Black Eye, and

Whip-poor-will, with a fair quantity of matured pods, also made very good hay; but several varieties in vigorous growth and with only occasional ripe pods when mown produced hay of very inferior quality.

Where cowpeas are grown between the rows of corn they are frequently harvested by pulling the vines by hand and throwing them into small cocks for curing. This method is applicable only on small farms, and the usual and most practical method of harvesting is with the mowing machine. Varieties of prostrate growth, however, are not very readily cut with the machine, and in growing cowpeas for hay the habit of growth must be taken into consideration and varieties more or less upright be selected in order to facilitate harvesting and curing. New Era, Whip-poor-will, and Wonderful are suggested as being well suited to harvesting with the mower.

Vines having ceased to grow and matured enough for hay may be sufficiently cured for storing in thirty-six or fortyeight hours of favorable weather conditions, and if well cocked after lying a day will endure several days of rainy weather with but slight damage and cure into good hay. On the other hand, green and vigorously growing vines may not cure at all. The following directions for making cowpea hay are given:

The vines should be cut in the morning as soon as free from dew and when the indications are for favorable haymaking weather. The length of time the vines should remain in the swath depends upon the quantity of vine, degree of maturity, and the weather. A cloudless day, with high temperature, dry air, and high wind, will induce rapid curing, and with a combination of such conditions hay cut in the morning should usually be windrowed or cocked in the afternoon. As soon as the more exposed leaves are well cured, but not dry enough to crumble, the hay should be teddered or, in the absence of a tedder, raked into windrows. Having remained in windrows until the upper portion is well cured, the windrows may be rolled over, that the under portion may be exposed for a time. The hay is then thrown into cocks, where it remains until taken to the barn or stacked.

It is advisable to turn over the cocks a few hours before hauling, in order to expose them to the sun and to hasten curing.

Methods of curing cowpea hay around poles are also described. The vines when thoroughly wilted are stacked about poles seven to nine feet long, driven into the ground, and remain there until well cured. When longer and stronger poles are used crosspieces are nailed to them at right angles to each other, about one foot above ground and again several feet higher, and so on to the top of the pole. The green but wilted vines are placed about the poles and over the crosspieces to the top, where the stack is drawn to a point and capped. Curing is also accomplished by piling the vines around a simple framework of poles, leaving the stack hollow in the middle, and thus admitting a free circulation of air through the center. These methods of curing, however, involve much labor and expense and are not always practicable.

According to suggestions by Prof. W. F. Massey, of the North Carolina Experiment Station, cowpeas should be harvested for hay as soon as the first pods turn yellow, and the cutting should be done only in the morning under promising weather conditions. The vines should be tossed during the day by means of a tedder or by hand with a fork and raked into windrows that same evening. These are turned and dried the next day and cocked. After the

cocks have stood for a day and no further moisture can be wrung from the hay by twisting a handful of it with considerable force it is ready for the barn; but if moisture still appears at the twist, the cocks are turned over and rebuilt to hasten the curing and the time when the hay will stand the test.

The following methods of curing cowpea hay are given by W. R. Perkins, of the Mississippi Station:

The cutting is done when the crop is fully mature, which is about the time the pods begin to ripen and the foliage begins to change color.

The mowing-machine blade is kept sharp and run as close to the ground as possible. If the peas are in rows, the cutting can be done much cleaner and better with a very sharp hoe and at very little additional cost.

If the weather is good, as is usually the case when the crop is ready, August or September generally, the vines are raked up the same or the following day and put into cocks of the size that two men can handle with a fork when cured. They are left in the cocks for four or five days, being turned over once or twice during the time, then hauled to the barn or stack. In case they are put in a stack a good covering of grass hay is necessary in order to shed the water. The sides of the stack should be built straight up to prevent the water spoiling the outside hay.

Putting in cock is desirable because the hay is then cured by the circulation of air through it, and not in the direct sunlight. Any hay is better when cured in the shade.

If the weather is damp or rainy, the hay is not raked at all till cured, when it is carried directly to the place where it is to be stored. If it continues to rain for several days after cutting, do not touch the hay till ready to put up, and then be sure that it is dry when packed away. This is a precaution that must be observed in storing any kind of hay—do not put up when even moist with dew or it will mold.

The crop may sometimes be lost in a protracted wet spell, but can generally be saved in such condition as to make very good forage.

Methods of putting up green are practiced and are entirely satisfactory when the vines are so packed that air can circulate freely through them.

One of the methods of putting up green is to erect a stack pole and nail a strong crosspiece on the pole extending to the outer edges of the stack. Put on a layer of the green vines two or three feet thick, then nail on another crosspiece, and so on to top of stack, finishing off with grass hay. The crosspieces prevent the vines packing down closely and at the same time allow the air to enter the stack. Hay can be cured and kept by this method. It is somewhat more expensive than curing in the field, as it necessitates the handling of a great amount of water in the green vines, and the cost of stack pole, crosspieces, etc., amounts to something.—*U. S. Exper. Report.*

The Great Value of Crimson Clover as a Land Improver.

SUMMARY.

Crimson clover, tops and roots, thirty days before full bloom weighs from 37 per cent. to 60 per cent. as much as at full bloom, and is on an average just half grown.

For humus alone the early turning under of the clover is probably profitable, for while the amount is less, it seems to be in a more available form.

The proportion of roots to the whole plant ranges from 12 per cent. to 50 per cent. and averages about 30 per cent. The proportion fluctuates greatly and has little apparent connection with the stage of growth, sometimes increasing, sometimes diminishing toward full bloom.

The air-dry matter of the tops ranges from 14 per cent. to 27 per cent. seeming to increase slightly toward full blown.

The yield of nitrogen from the entire plant ranges from 139 to 188 pounds per acre, in one exceptional case amounting to 216 pounds.

The yield of nitrogen thirty days before full bloom ranges from one-half to fourteen-fifteenths of the yield at full bloom.

Crimson clover grown on a soil long accustomed to it seems to get its nitrogen comparatively early in its growth and so to gain little during the last month.

Crimson clover grown on a soil for the first time seems to gain nitrogen slowly at first and so to gain relatively much during the last month.

On soil long accustomed to crimson clover the loss of nitrogen from early plowing under is likely to be small. On soil growing the clover for the first time the loss of nitrogen may be considerable, but it is often counter-balanced by the greater convenience of the early plowing.

Of the total nitrogen in the plant in some cases as little as 12 per cent. is in the roots and sometimes as much as 50 per cent.

There is little apparent connection between the stage of growth and the distribution of nitrogen between the tops and the roots.

On an average about one-fourth of the total nitrogen in the crop is under ground. Where a crop of clover is cut for hay or seed, the stubble adds to the nitrogen left to the soil, making it average 35 or 40 per cent. of the total nitrogen.

The percentage of nitrogen in the tops drops on an average about 1 per cent. and that in the roots about 1-3 per cent. during the thirty days preceding full bloom.

Not all of the nitrogen in crimson clover and other leguminous crops is "new" nitrogen assimilated from the atmosphere, but some of it and in certain cases probably the larger part is taken from the soil and thus represents no gain in nitrogen fertilizer.

Where crimson clover gains but little nitrogen during its later period of growth, it is probable that much, perhaps most, of its nitrogen, is not "new," but is merely worked over from the supply previously stored up in the soil.

Of the total nitrogen in the tops about two-fifths is in the stems and the remainder about equally divided between the leaf blades and the blossoms.

After full bloom the nitrogen continues to move from the stem toward the blossom, the latter becoming the richest part of the plant.

The potash in crimson clover varies greatly in amount, in some cases exceeding the nitrogen, in other cases being less than half as much. The yield ranged from 63 to 185 pounds per acre and in an exceptional case 255 pounds.

The amount of potash usually increases during the last thirty days before full bloom.

The percentage of potash in the tops is always higher than that in the roots, with little connection between the two.

Of the total potash in the plant the roots contain from 4 per cent. to 27 per cent., and on an average about 17 per cent.

The total phosphoric acid in the entire plant ranges from 11 to 38 pounds per acre. The percentage of phosphoric acid is rather uniform.

During the thirty days preceding full bloom the clover gains in the money value of nitrogen alone from .94 to $9.07 per acre.

The total money value of the nitrogen alone in the matured crop ranges from $16.72 to $22.54, and that of nitrogen, potash and phosphoric acid together from $20.57 to $32.85 per acre.

1. *Object.*—The purpose of this investigation is primarily to determine whether crimson clover in its early spring growth at about the middle of April contains much less nitrogen than at full-bloom. At the former stage the plant is usually in this climate a few inches long, three or four inches, simetimes six or eight inches, lying close to the ground, and of a scattered and uneven growth. It is evident that the crop as measured by the eye increases from this stage to maturity very much, apparently several fold. Does the nitrogen increase proportionately? Does it increase even more than the weight of the crop? Does it increase at all? May it not even lose in weight? These are all questions of great interest theoretically and of great importance in practice. If the clover gains nothing in nitrogen during its last month of growth it may obviously without loss be turned under so much earlier in the season and be better utilized as a green manure.

Fruit growers, especially, who use crimson clover in their orchards desire for several reasons to turn it under early in the spring. Many of them, although believing that they were losing much of the benefit of the crop, have in spite of their belief felt impelled to this course because of its greater convenience in their system of farm management and also because the later ploughing is not infrequently hindered by drought. With no other guide than the eye as a judge it is natural to suppose that the matured crop is very many fold greater in every respect than the early spring growth, certainly greater in tonnage of dry-matter and probably much greater in its chief constituent of value, nitrogen. We are familiar with the fact that many crops, whether fruits or cereals, gain chiefly as they mature. A sugar plant, for example, forms nearly all of its sugar during the last few weeks of active growth and its percentage of sugar rises toward maturity more rapidly than that of any other constituent. Then is it not probable that a *nitrogen-growing*

plant should gain by far the greater part of its nitrogen during its ripening period? It would seem to be so. The "nitrogen-growing plant" is, however, peculiar in that its fruit, to call it so, that is, its nitrogen, is not seen or known by any common test. We may judge by the eye and taste of most crops, but the fruit of the "nitrogen-growing" plant, that is, its nitrogen, can only be known and measured by means of anaylsis. Then it is important to all who use crimson clover to know how rapidly it gains in tonnage during the period in question, its later growth, and far more important to know how its percentage of nitrogen changes. Aside from the nitrogen question it is interesting to study the habits of the plant in respect to its use of potash and phosphoric acid.

2. *Yield of Dry Matter.*—We have to consider first the weight of the air-dry material of the entire crop, and next the distribution of this between tops and roots.

The first cutting of the Nivin experiment was made on April 18, 1903; that of the Casho experiment on April 20, 1903; those of the Derby experiments on April 22, 1901, and April 21, 1903; and that of the Experiment Station plot on April 26, 1901. On these the earliest dates of sampling, the clover varied in length from three to six inches, usually lying close to the ground and being so uneven as to make exact description impossible. The growth thereafter in the case of those plots sampled repeatedly seemed to be proportional to the time. Following is shown the average weight of the total plant in pounds of air-dry matter per acre, the roots being estimated to a depth of twenty-four inches.

In the period covered, preceding full-bloom from twenty-four to thirty-two days, the total weight of air-dry matter in roots and tops varies from 33 to 67 per cent., or between one-third and two-thirds of the weight at full bloom. Of course this is but another way of saying that in some cases by reason of different climatic or other conditions, the plant is at a less advanced stage of its growth a month before full bloom, that is, it grows faster than in certain other cases.

The comparison will be more enlightening perhaps if we estimate all of the experiments at the uniform period of thirty days before full bloom; thus the *percentage of growth*, that is, the proportion that the air-dry matter bears to that at full bloom regarded as 100 is as follows:

Thirty days before full-bloom

The Nivin experiment shows 37 per cent. of growth.
The Station experiment shows 48 per cent. of growth.
The Derby 1903 experiment shows 51 per cent. of growth.
The Casho experiment shows 52 per cent. of growth.
The Derby 1901 experiment shows 60 per cent. of growth.
The average experiment shows 50 per cent. of growth.

As an average, thirty days before full bloom, under our conditions, the weight of the total plant is just one-half of its weight at full bloom.

3. *Nitrogen.*—The most interesting question concerning crimson clover is its nitrogen content. For this exclusively it is often valued, although as a

green manure it is useful for other reasons. The nitrogen found in the whole plant, tops and roots, at the time of full-bloom, averaged 146 pounds per acre for the Nivin experiment, 162 pounds for the Casho experiment, 181 pounds for the Derby 1903 experiment, 139 pounds for the Derby 1901 experiment, and 188 pounds for the Station experiment. In one extreme case No. 9 of the Casho experiment, the clover grown on the site of a burnt brush heap described above, was found to contain nitrogen equivalent to 216 pounds per acre, and that before the plant was fully developed, valuable at $26. This is the largest yield of nitrogen that we have found thus far in any field crop. It is in no sense abornmal except that the soil was highly fertilized with potash from burnt brush and the potash in the soil had been "unlocked," that is, rendered more available by the heat from the fire. It is well worth noting that this unusual yield of nitrogen was obtained from the clover grown on the ashes of burnt bush and that another remarkably high yield of nitrogen, that of the Derby experiment of 1903, which reached 189 pounds per acre in one case, and averaged 181 pounds, was grown, as described, on orchard land that had been dressed with wood ashes about the trees. Potash salts or at least this form would seem to be a powerful stimulus to the clover growth.

4. *Nitrogen at Different Stages of Growth.*—It is important to consider how the yield of nitrogen changes with the growth of the plant, in fact, it is of prime importance as touching the question of loss in the early ploughing-under of the clover. This question is: Is the amount of nitrogen proportional to the dry-matter; that is, does it like the dry-matter double itself during the last month of growth, or does it gain faster than the dry-matter, or again does it gain less than the dry-matter? This is a question of supreme moment; on its answer depends in a large measure the most economical utilization of crimson clover for nitrogen. The answer is found in the yield of nitrogen at different stages of growth. It will, perhaps, be clearer if, in addition to the yield of nitrogen in pounds per acre, we consider what proportion of the nitrogen yielded at maturity is yielded at the earlier stages. This is shown in the following table in which the average weight of nitrogen in pounds per acre in both tops and roots estimated to a depth of twenty-four inches is shown and in addition to this the percentage that each yield is *of the average yield of its own field at full-bloom.* For example, the average yield at full-bloom for the Nivin experiment is 146.0 pounds of nitrogen per acre, now the yield of the first plot on April 18 is 65.5 pounds and this is 45 per cent. of the average yield at full-bloom, so that we may consider the crop at that time, April 18, and on the particular plot selected as worth in point of nitrogen 45 per cent. of its final value at maturity.

Average Number of Pounds in Nitrogen Per Acre in Entire Plant, Tops and Roots Together, with the Relative Yield at Different Stages of Growth.

The roots are estimated to a depth of twenty-four inches.

	Date.	No. days before or after full bloom.	Pounds of Nitrogen per acre.	Per cent. of yield at full bloom.
Nivin Expt.	April 18, 1903	32 before	70.4	48
	April 23, 1903	27 before	81.4	56
	May 2, 1903	18 before	106.7	73
	May 12, 1903	8 before	118.5	81
	May 20, 1903	o	146.0	100
	June 19, 1903	30 after	43.5	31
Casho Expt.	April 20, 1903	29 before	105.1	65
	April 29, 1903	20 before	129.4	80
	May 11, 1903	8 before	136.1	84
	May 19, 1903	o	162.1	100
	May 29, 1903	10 after	133.7	83
	June 5, 1903	17 after	109.7	68
	June 11, 1903	23 after	94.7	58
Derby Expt.	April 22, 1901	25 before	131.5	95
	May 17, 1901	o	139.3	100
	April 21, 1903	24 before	169.1	94
	May 15, 1903	o	180.5	100
Station Expt.	April 26, 1901	26 before	124.0	66
	May 22, 1901	o	188.2	100

As an average of all of our work we find during the growing season 27 per cent. of the total nitrogen to be in the roots. Then as a general rule with wide deviation in particular cases, *about one-fourth of the nitrogen of crimson clover is under ground, and about three-fourths above ground.*

It should be borne in mind, however, that where clover is cut off for hay or seed, the *stubble*, which is here reckoned with the tops, remains on the ground and adds greatly to the nitrogen left available to the land. Probably 35 to 40 per cent. would represent the *average* proportion of the nitrogen that is left to the land when the clover is cut, and in many cases more than one-half is left.

5. *Yield of Potash.*—Potash is a plant-constituent that fluctuates in percentage through a very wide range. In some cases in the same plant it makes up nearly half of the ash and in others a very small fraction. Crimson clover especially is a heavy consumer of potash where it is offered in abundance, and we sometimes find its percentage higher than that of nitrogen.

The amounts of potash that our several experiments have yielded at full-bloom expressed in pounds per acre for the whole plant, the roots being estimated to a depth of twenty-four inches, is as follows:

Potash at full bloom—

Station experiment—185.4 pounds per acre.
Nivin experiment—164.9 pounds per acre.
Derby 1903 experiment—156.5 pounds per acre.
Casho experiment—65.0 pounds per acre.
Derby 1901 experiment—62.6 pounds per acre.

In contrast with this wide difference of three to one, the nitrogen from the different experiments as given above lies between 188 pounds and 139 pounds

per acre. The yield of potash from the special plot No. 9, on Mr. Casho's place, the site of the burnt brush heap, was 255.4 pounds per acre, the largest yield that we have ever met from any crop, equivalent to over 500 pounds of the muriate and on the commercial basis valuable at $10 or $12 per acre.

6. *Phosphoric Acid.*—The phosphoric acid contained in the entire plant has been found among the several plots to range between 11 and 38 pounds per acre, with exception of the Casho plot No. 9, which showed 52 pounds. The amount generally increases as the clover matures, but not always. The Derby 1903 plot, as in the case of potash, shows a loss, dropping from 38 to 27 pounds during the last twenty-four days preceding full-bloom.

7. *Money Valuation.*—It is a forcible but sometimes misleading presentation of the utility of green manures to put a money valuation on them. Properly understood, however, such a view should be enlightening. A money valuation of a clover crop is no more difficult than that of commercial fertilizers, but both are exceedingly difficult if the valuation is intended to show just what profit the fertilizer, whether a clover crop or a phosphate, will bring to the farmer. This the valuation placed on the commercial fertilizer does not purport to do, and it should not be so understood. When a potash mixture, for example, is valued at ten dollars a ton, it is not meant that it will repay the user of it to that amount. It may bring no return whatever, or it may bring several times ten dollars. What the commercial valuation does mean is to show the *cost* of ingredients at prevailing prices, not their value to the purchaser.

Now while the fertilizing material locked up in a plant is not for the present in the same instantly available state as nitrate of soda or muriate of potash, it still has a value, and we may come as near to expressing that value in money as we can the *value* (but not the *cost*) of a commercial fertilizer, always with the understanding that green manures are necessarily slower in their action than ready-to-use soluble commercial salts of potash or nitric acid. There is at present no analytical method or scheme of prices that will foretell the return in profit from using a ton of fertilizer, whether it be a ton of clover, of stable manure or of commercial phosphate.

Money valuations are useful, however, as a means of instructive comparison between different samples of the same kind or between different kinds of fertilizer, but not as an expression of actual financial return to be expected. Just as the chemical salts, valued at ten dollars because they cost that sum, may bring fifty dollars return or no return at all, so a green manure valued at the like sum may bring similar returns, that is, sometimes a high return and sometimes none. In either case it is a question of need and suitability that so often has to be settled by experience. But of two commercial fertilizers valued at ten and twenty dollars, respectively, we may fairly expect if they be wisely used, the one to be worth more than the other; so in the comparison of different clover crops or of clover and cow peas, for example, we may rate them on their money valuation with equal confidence.

In regard to the valuation of nitrogen we meet the difficulty, as we have seen above, that some of the nitrogen in clover is not "new," merely soil-nitrogen worked over. This, of course, introduces some uncertainty, for we do not know exactly how much is a gain and how much is merely taken from

one place to appear in another. In the potash and phosphoric acid nothing new has been added to the soil at all; there is merely a change of form. But this change is often nearly as great a gain as so much new material, for a plant that is a vigorous forager makes available for following crops the mineral matter that otherwise is taken up with difficulty. Just as phosphoric acid in untreated mineral phosphate is valued at two cents and the same material after treatment with acid at more than double that price, so the soil minerals once taken up by a plant and rendered soluble, like the phosphatic rock "cut" with sulphuric acid, are greatly enhanced in value. Even if a green manure crop leaves in the soil no potash and phosphoric acid that it did not find there, it leaves them nevertheless in a more available form for following crops; it has in a sense manufactured an acid phosphate.

The large amount of potash noted as following the treatment with wood ashes cannot, however, be considered as entirely of the improved or enhanced sort, for the ashes alone were already highly available. But a certain portion, and, in fact, a large portion, is doubtless taken from the original soil, the ashes merely serving to stimulate such a growth as renders this active foraging possible.

The averages of the several plots for the different stages of growth may be valued, as shown in the following table, on the basis of 12 cents a pound for the nitrogen, 5 cents for the potash and 3 cents for the phosphoric acid. In the case of the last it must be rated lower than acid phosphate because of its slow action and less soluble form. Similarly vegetable nitrogen can hardly be rated as fully equal to nitrates.

If the money valuation seems to be unreasonably high, it may be interesting to quote the words of a farmer who has grown crimson clover for many years and thinks he has greatly improved the quality of his land thereby: "If I were offered the choice of twenty-five loads of stable manure per acre, worth a dollar a load, free of cost to me and put on the land free of cost, or my crop of crimson clover, I should refuse the manure and take the clover."

To summarize the money valuation, it would seem that the several crops gain during their last four weeks as follows:

Crop.	*Length of period before full-bloom.*	*Gain in value of nitrogen alone.*	*Gain in total fertilizing value.*
Nivin	32 days.	$9.07	$13.80
Station	26 days.	7.66	10.83
Casho	29 days.	6.86	8.24
Derby 1903	24 days.	1.35	Loss 0.05
Derby 1901	25 days.	0.94	1.13

8. *The Mechanical Value of the Roots.*—The mechanical value of the clover roots, especially the fine filaments, can hardly be estimated in money, but it is none the less real than the chemical value. This mechanical value is commonly included among the useful properties of *humus*, though hardly properly so. Humus proper has lost all semblance of its original form, as of leaf, stem or root, and has become an amorphous substance. The improved mechanical quality imparted to many soils by vegetable matter, such as the

rendering of stiff clay soils open and porous, and the binding together of light sandy soils, is due chiefly to vegetable fragments, such as straw, and especially fine roots, before they have entirely disintegrated or passed into the state of humus proper. The property of rendering stiff soils porous and open is doubtless due to the penetration of stems and roots through the soil which thus open up passages for the circulation of air and water. A great multitude of fine passages is the most efficient to this end. Thus the roots of the plant, especially the fine filaments, in their natural position open up the circulatory passage ways more minutely and completely than any system of tillage can do. And they not only open the passage ways, but they keep them open as well. A ton of roots in their natural position must be rated in point of mechanical value, but, of course, not of chemical value, higher than several tons of green crop turned under. The distribution of the latter can never approach in completeness the fine even subdivision of the rootlets.

In the 1901 Derby experiment (14th Annual Report, page 84) the roots in one acre to a depth of two feet were estimated to have about four acres of surface. This large surface for absorption makes it clearer how so great a weight of mineral matter can be taken up through the roots. The highest yield of mineral matter found in our experiments, namely, 255 pounds of potash per acre from Casho plot No. 9, would have, at this rate, as an absorbing surface to drink it in, over 170,000 square feet of root surface or nearly 700 square feet of root surface for each pound, equivalent to only ten grains of potash absorbed by a square foot of root surface during the entire growing season. Thus it is clear that the fineness of the roots which greatly multiplies their surface is an important matter. The improved mechanical state that the fine crimson clover rootlets impart to many soils must be rated next to the nitrogen assimilation as one of the chief fertilizing properties of the crop.—*Delaware Experimental Station Bulletin* 67.

A Large Grower of Cow Peas.

One of our large Charles City county farmers, Mr. E. A. Saunders, Jr., sowed this year one thousand bushels of cow peas and one hundred and sixty acres in alfalfa, and has sowed fifteen hundred acres in wheat, and will plant one thousand acres next spring in corn. Mr. Saunders is a strong believer in the value of the cow pea as a land improver, and his large crops show their benefit to the land. Every farmer should each year grow some of the leguminous plants. This wil enable him to lessen his fertilizer bills by making his own nitrogen through these leguminous crops.

Breeding Seed Peanuts.

Virginia is the greatest peanut producing State. About one hundred thousand acres are grown annually, producing over four million bushels. The yield is from thirty to seventy-five bushels per acre. This yield can be

greatly increased. An important matter in securing this increase is by improved breeding of the nut. The following article by Prof. W. F. Massey contains valuable information to the peanut grower:

BREEDING SEED PEANUTS.

PROF. W. F. MASSEY, ED. "PRACTICAL FARMER."

The peanut is no exception to the rule that "whatever a man sows, that will he reap." If one plants the product of enfeebled plants—small, stunted seed of low vitality—he will certainly get an inferior product. Many imagine that the improvement in plants is generally brought about by some mysterious hybridization or crossing, when, in fact, with plants that are grown from seed, any crossing of varieties gives only the starting points for improvement. The real secret in the improvement of any plant lies in the careful and continued selection from year to year of the plants that come nearest to one's ideal of what the perfect plant of the kind should be.

The proper care in selecting the seed will be certain to improve the character and productiveness of any crop, and the peanut crop is no exception. In taking up the crop, go through the field and observe the habit of the individual plants. Select seed only from plants of abundant vitality and vigorous growth. In taking them up, note the product of each plant and shock the productive plants by themselves to be saved for seed. Now, from these selected seed, the next season plant your crop and also plant a special seed patch, giving it the best possible attention and fertilization. Then, from this patch, continue the selection of the best plants that bear the heaviest crop of nuts and have the best habit of growth. Continue this from year to year, and you will find that in a few years you will have bred the variety, no matter what the variety is, to a far greater production. Planting only the best developed nuts from the most productive hills, you will increase the crop in a few years, as much as by the permanent improvement of the soil itself. Get well fixed in mind what you would consider the perfect plant of the variety you grow, and always select towards that ideal type. You may not get the perfect plant you imagine, but you will certainly get a variety that will attract the attention of all the growers around you, and make your peanuts more valuable for seed than for the general market, while the price on the market will be better for properly-bred and improved nuts. While the plant breeders have been improving corn, wheat and other crops by seed selection, there has been little done in the improvement of the peanut, and there is a wide field for its improvement.

One reason for the planting of a separate seed patch every year is to get the best plants by themselves and removed from any inferior surroundings, for in the seed patch one can pull out and remove inferior plants and not allow them to influence those around them when their blossoms are maturing the pollen. In the breeding of any plant, this removal of surrounding inferior type is a matter of importance.

Therefore, in a seed patch of peanuts, I would pull out every runt plant that showed itself and not allow it to have any influence on the crop, and I would rigidly examine the crop of every plant at digging time and select only the very best to plant the seed patch the following year, using the rest for the

PORK MADE AT LESS THAN THREE CENTS PER POUND.
Fattened on Virginia Cow Peas.

general crop, and thus, year by year would be advancing. With well-selected seed and good farming with the peanut crop, there is no reason why one hundred bushels per acre should not be a common crop.

I have long had a notion that the prevalence of "pops" is due more to the failure of the blossoms to get fertilized than to the lack of lime. The effect of lime is mainly through aiding the activity of the bacteria that live in the roots of the plant and enable it to get the nitrogen from the air, and thus increasing the general vigor of the plant and the perfection of the flowers. It is well known that these bacteria will not thrive in an acid soil, and most of the lands that are devoted to peanuts have gotten into an acid condition.

Many of our peanut growers have a prejudice against the cow pea as an improving and forage crop, and claim that good peanuts cannot be grown after cow pea, both these being legume crops, I would not follow a pea crop at once by peanuts, but I would certainly have peas in the rotation of crops for the improvement of the land, and through the vegetable matter they leave in the soil to render the liming of the peas more effective. Farming, in a good rotation of crops with peanuts as the money crop, can be done as well as with any other crop, and the Southern pea will make the best of all agents in the improvement of the soil.

Peculiarities of the Peanut Plant.

There are some peculiarities of the peanut that might well be noticed. While the pindar is a leguminous plant, it is an underground legume—one that grows and matures its seed-pods beneath the soil. Hence the specific name by which it is known and described—*hypogaea*.

The small, yellow, butterfly-shaped flowers appear on stems that spring out from the axils of the branches above ground, which stems (peduncles) increase in length till they reach and penetrate the soil about the plants. As the flower fades and falls off, the germ of the future pod begins to form at the end of the stem, and once the peduncle has found its way into mellow soil, the pod begins to grow rapidly. If the stem fails to reach the ground, no pod is formed.

Another interesting peculiarity of the peanut is its habit of closing each pair of leaflets together, like the covers of a book, on the approach of night, or when a shower begins to fall upon them. The leaflets are in pairs, and as darkness and dewy eve come on, each pair begins gradually to approach nearer and nearer together, until they meet and stand erect, edge up, and remain so through the night.

The formation of numerous small nodules upon the roots of this plant, as it aproaches maturity, is a third peculiarity that attaches to it, in common with some other plants of the same order. These nodules are always present; but they are more numerous and better developed whenever the plant is grown on a light, porous, sandy loam, such as suits the peanut best. The presence of these nodules indicates thriftiness and vitality in the crop, and when they are few in number, and small, the soil is not either suited to the

peanut, or it needs amendment and fertilization. These protuberances have been called bacteria nodules, their office being to assimilate and appropriate the nitrogen gathered by the plant from the atmosphere. Whenever these nodules are abundant, and they nearly always are in a loamy, calcareous soil, the crop will be a large one.

Perhaps it is proper to mention the marked cinnamon-yellow color of the roots as a peculiarity of the peanut. It is a very noticeable feature, and perhaps there may be some, as yet undiscovered, medicinal virtue attached to these roots. This seems to be indicated by their bitterish taste, when chewed.

Fattening Hogs on Peanuts.—Courtesy American Nut Journal.

There is one more fact concerning the peanut which may be regarded as peculiar to it. It has no insect enemies, so to speak. That is, the plant is very rarely attacked or fed upon by any insect—certainly never to the detriment of the crop. Of what other farm product can this be truthfully said?

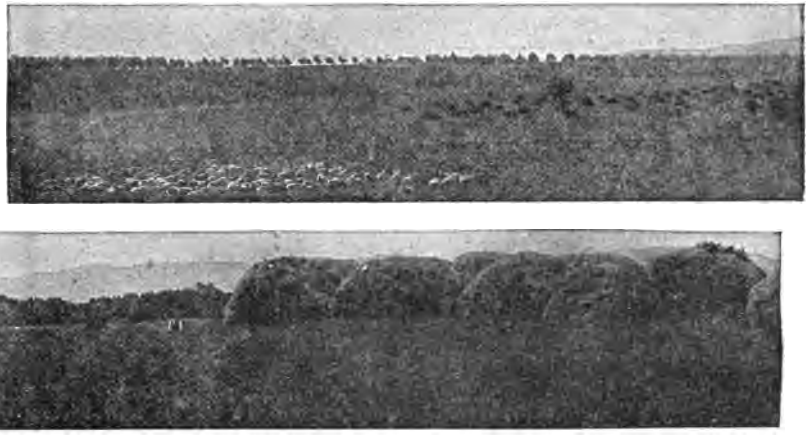
Peculiar in its habits and mode of growth, the peanut has much to interest the botanist, as well as much to recommend it as a profitable agricultural staple.

A 300-Acre Peanut Field Near Petersburg, Va.

The Triumphant Eastward Progress of Alfalfa.

HOW IT IS FREQUENTLY REPLACING CLOVER IN THE STATES WHERE IT FAILED TO DO SO TWENTY YEARS AGO—WHY MOST EASTERN FARMERS FAILED WITH ALFALFA THEN, AND WHY SOME DO NOW—THE LIMITATIONS OF ALFALFA.

The supreme test of good farming is large crop production without loss of soil fertility and without the use of artificial fertilizers. Every real farm should be made self-sustaining. In order to accomplish this result it is necessary to raise some leguminous crop. In the South cowpeas serve this purpose; in the Central, Northern and Eastern States red clover; and in the Rocky Mountain and Pacific Coast regions alfalfa. These three legumes have competed for supremacy and each has ardent champions. Alfalfa, however, has rapidly extended its dominion and is now recognized as the best leguminous crop for all parts of the country. In the Far West it has long been supreme. It has recently demonstrated its superiority over cowpeas in the South and over red clover in the East.



The best hay in the world for the winter feeding of animals—alfalfa.

The chief advantages of alfalfa are:

1. *Permanence.*—When once established it stands and may be continuously cropped for ten to thirty years or more without reseeding.

2. *Enormous Yield.*—It yields from three to seven crops per year according to the latitude. The annual yield is two to five tons of dry hay per acre or seven to eighteen tons of green forage. The yield of dry forage thus greatly exceeds that of corn, red clover, crimson clover, or cowpeas.

3. *High Food Value.*—The protein content of an annual crop of alfalfa is four times as great as that of red clover and more than five times as great as that of cowpeas or corn.

4. *Economy.*—Alfalfa supplies so much protein that it may be used to replace much of the grain in rations for dairy cows, beef cattle and fattening

sheep. The expense of feeding is thus greatly reduced, since protein is the most expensive food element. Alfalfa is the best known soiling crop for dairy cows and maintains a good milk flow even when no grain is fed. Alfalfa hay contained 14.3 per cent. protein; red clover, 12.4 per cent.

The two rivals side by side on May 4th on the same Eastern Farm.

Red clover only six inches high and considerably wilted by a drought which did not effect the alfalfa. Photographed in the District of Columbia.

Alfalfa thirty inches high. This field has yielded four crops every year for the past twelve years without reseeding.

5. *Earliness.*—It starts very early in the spring, and the first crop may be cut fully one month in advance of red clover.

6. A *Fertilizer.*—Alfalfa gathers nitrogen directly from the air like red clover and thus improves the fertility of the soil.

7. *It Improves Soil Texture.*—The roots penetrate much deeper than red clover, however—usually from five to forty feet. The roots thus secure a

water supply when red clover would fail on account of drought. By reason of the deep penetration of the roots, plant food is brought up from greater depths than any other crop can reach and the total available supply of plant food is greatly increased. In other words, alfalfa can get more out of the soil without impoverishing it than any other crop. On the contrary, the soil is greatly improved by the addition of nitrogen from the root tubercles, by the addition of humus from decaying roots and by the disintegration of the subsoil through the agency of the roots.

Alfalfa occupies the ground completely and exterminates the weeds generally.

8. *Palatable.*—Finally, alfalfa is greatly relished by all farm animals and is very effective in the production of milk, beef, pork, mutton and in the maintenance of horses and mules.

Alfalfa or lucerne was introduced into New York in 1820, but did not attract much attention at first. In 1857 it was brought from Chile to California, whence it spread rapidly over the Western States, replacing other less desirable forage plants, steadily increasing its fame and finally forcing itself upon the attention of Eastern farmers.

When Alfalfa hay is bunched it lies loose and therefore does not shed water well.

THE PECULIAR LIMITATIONS OF ALFALFA HONESTLY STATED.

Alfalfa requires twenty inches or more of water per year. Where the rainfall is less than this the crop should be irrigated. A well-drained loamy soil with open subsoil for penetration of the roots is usually recommended. An acid soil is unfavorable for alfalfa, but this defect may be remedied by the use of lime. The crop does not tolerate an excess of water in the soil. It is destroyed by flooding, if the water stands on the crop for more than forty-eight hours. Flooding in winter, however, is less harmful than in summer. The water table in the soil should be below four feet—twenty to thirty

feet is a better depth. In swampy or poorly drained soil alfalfa will not grow. If drainage is good the character of the soil is not of so much importance. There are thrifty crops of alfalfa in the Eastern States on sandy, loamy, gravelly and even hard clay soils.

The soil requirements of the plant are therefore not very strict except as to drainage. With regard to location alfalfa has been grown successfully in every State and Territory of the Union, and in Ontario and other parts of Canada. There are fields in New York which have yielded continuous crops for thirty years, and one field in the same State has borne three crops annually for twenty years on soil which the casual observer would consider better suited to brick making. Alfalfa is creeping northward year by year in New York, Wisconsin and Minnesota. After many years of experience with the crop, the New York State Experiment Station concluded that "alfalfa is not suited to all kinds of soil," but is "a plant of such decided value that it is well worth a trial in any locality where there is a fair prospect of its growing."

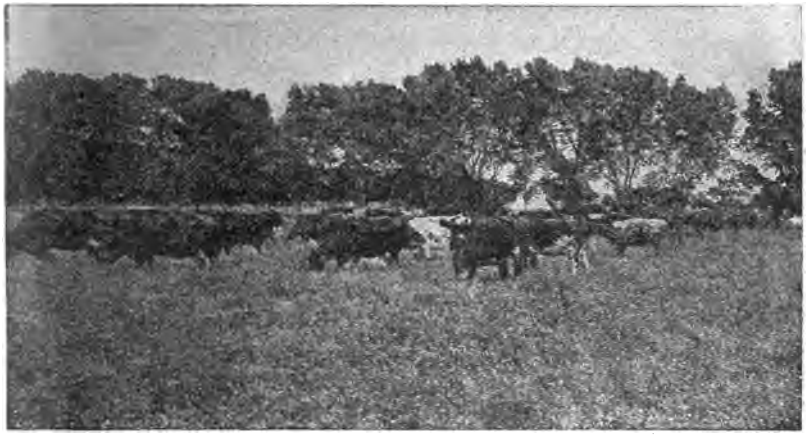
It may be necessary to interrupt the cutting to get the down-lying hay in cocks before it dries.

THE FIRST CRITICAL PERIOD—PREPARATION OF THE GROUND AND SEEDING.

The preparation of the seedbed for alfalfa is an important matter and should always receive careful attention. The young plant is very delicate, and since it may be expected to yield heavy crops for at least ten years, the farmers can well afford to spend the time and energy necessary to put the soil in just the right condition for seeding. The soil should be thoroughly pulverized to the depth of three or four inches. This constitutes a true soil mulch and prevents surface evaporation. Below the soil mulch for a depth of four to six inches the soil must be mellow, but thoroughly compacted. In such a seedbed moisture is brought up by the capillary action of the soil as far as the surface soil mulch, where it is retained for the use of the germinat-

ing alfalfa seed and the young, growing plants. If the soil is left too loose below, the capillary action is disturbed and the plants suffer from drought. This matter is important for cereals and other crops, but it is vital for alfalfa. In soil that has been in corn or some similar crop a thorough surface cultivation without plowing makes an excellent seedbed for alfalfa.

The young plant needs all the help it can receive. If the soil is deficient in any of the plant foods they should be supplied in abundance. For this purpose about thirty-five bushels of lime per acre should be applied in the fall; seventy-five pounds nitrate of soda, 100 pounds muriate of potash and 150 of acid phosphate just before seeding and a good dressing of manure in the fall after the last crop has been cut. The manure should be fine and evenly applied with a manure spreader. The right condition of soil fertility can be secured by growing clover or peas on the land just before seeding to alfalfa. Newly plowed meadow or pasture land, however, is not suitable, since the soil cannot be made sufficiently compact.



Cattle are fond of alfalfa in any form.

In the South it may be sown in the fall so as to give the crop a good start before winter. Alfalfa should not be sown with a nurse crop, such as oats or wheat, but alone. The seed should be plump, bright and free from weed seeds. Good seed is of a greenish-yellow color and resembles that of red clover, but is somewhat larger. If held over for several years the seed shrinks and the color darkens. About 90 per cent. of plump, fresh seed will germinate. The germinating power gradually declines with age until in ten-year-old seed it is only about 50 per cent. The seeds of dodder, one of the worst enemies of alfalfa, may be found in the alfalfa seed. They are smaller than the latter and more angular; they may be removed by thorough cleaning. Alfalfa seed is often adulterated with yellow trefoil seed, which may be distinguished by its darker green color, or with bur clover seed, which is lighter in color. Only high-grade, clean seed should be sown. The quality of the seed may be readily determined by a germination test such as any farmer can make at home. In this country the production of alfalfa seed is confined to the region west of

the Missouri river, where the best conditions prevail for the proper ripening of the seed. The average yield is from five to ten bushels per acre.

The amount of seed to be sown per acre varies from ten to thirty-five pounds according to local conditions. If broadcasted, more seed is needed than if sown by drill. As a rule twenty pounds of good seed is enough per acre. The soil may then be lightly harrowed and rolled. Whether drilled or broadcasted, the seed should not be put too deep in the ground. A depth of one-half to one and one-half inches is about right. If covered three inches deep the young plant may never reach the surface. There are about 200,000 alfalfa seeds in a pound. Consequently if twenty pounds are sown per acre, with a germination of 90 per cent. there would be more than 3,000,000 plants per acre. An examination of a good alfalfa field, six months old, indicated about 650,000 plants per acre. The use of twenty pounds of seed, therefore, assures a good stand after allowing for the loss from various causes of more than two-thirds of the plants.

The young alfalfa plant cannot endure weeds. One of the objects of thorough cultivations before seeding is to eradicate weeds. If the preliminary cultivation is right, fall-seeded alfalfa needs no care until it is ready to cut in the spring. Where weeds are prevalent, spring-seeded alfalfa may have to be mowed three or four times during the first season to keep down the weeds. For this purpose the cutter bar should be set high and the weeds allowed to lie on the ground as a mulch. Cutting also improves the vigor of the young alfalfa. Under these conditions no crop will be obtained the first year. On rich, clean soil, however, two crops may be expected during the first summer. Alfalfa should not be grazed until the second year, never in winter.

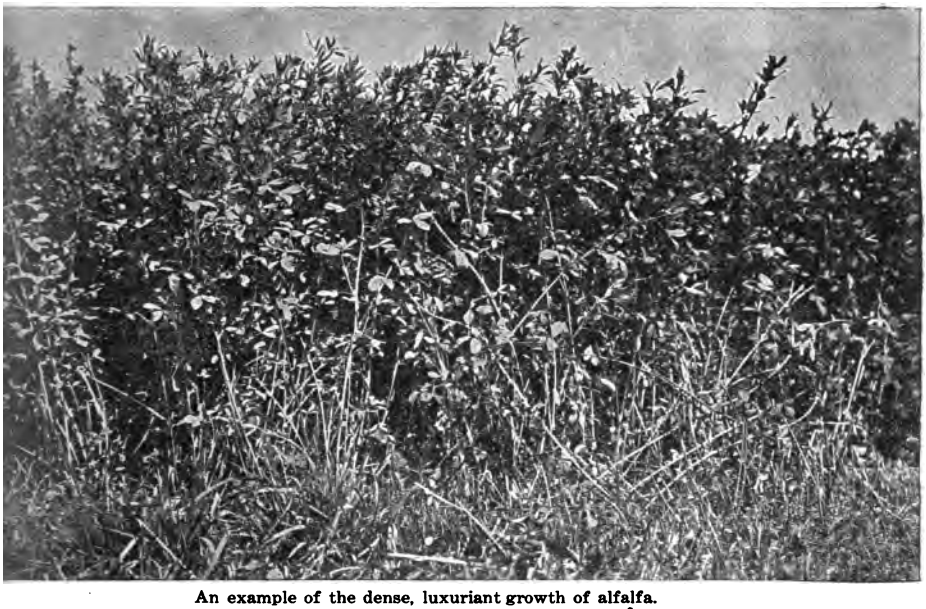
After becoming established the characteristic features of alfalfa appear. It is a perennial, of upright growth, with long raceme of purple flowers and with three comparatively narrow leaflets for each leaf. At the surface of the ground a crown is formed from which numerous branches appear—as many as 350 or more in old plants. The bases of these branches lie horizontal at the surface of the ground, and may develop roots. An old, much-branched plant may therefore be divided into several independent plants by means of a disk harrow. In fact, this treatment has been found to improve old alfalfa fields. The single tap root penetrates rapidly into the soil and to great depths. Mr. C. W. Irish records finding one which had penetrated 129 feet! When the stems are cut or grazed off, the stubble dies down to the crown and new stems appear from new buds.

Some difference of opinion prevails regarding the comparative merits of different varieties of alfalfa. Common alfalfa is the variety most widely cultivated. Turkestian alfalfa has rather smaller stems and in the arid West endures drought and freezing better than common alfalfa. In the East and South, however, it does not compare favorably with the latter. In Michigan and elsewhere another variety has been grown under the name sand lucerne, but its agricultural status has not been determined.

THE SECOND CRITICAL PERIOD—CUTTING AND CURING THE HAY.

Alfalfa should be cut just as it begins to bloom. The next crop develops much more promptly than when the preceding crop is allowed to come to full flowering. Alfalfa cut just before blooming is more nutritious than when cut in full bloom or a week later. The best feeding value is secured if cut between medium bloom and the first full flower.

Alfalfa hay cannot be cured like timothy. It should be cut in the morning and left lying merely long enough to wilt. Then rake it into windrows for



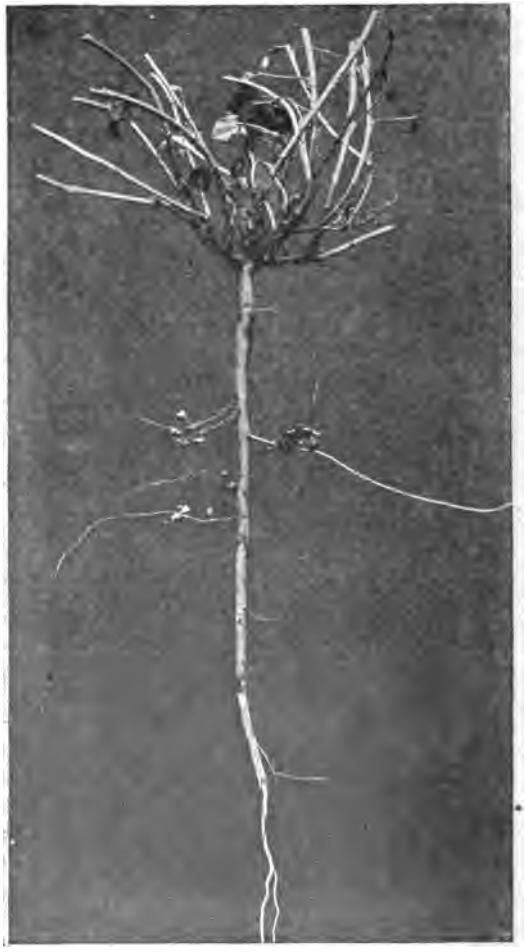
An example of the dense, luxuriant growth of alfalfa.

a few hours, put it into cocks and let it cure for two or three days, depending on the weather. In rainy weather hay caps should be placed on the cocks, since the hay is greatly injured by rain. Alfalfa must not be allowed to become dry before raking, for then the leaves shatter in handling. The leaves are two or three times as nutritious as the stems. If the first crop comes in very rainy weather it may be put into a silo. Alfalfa makes good silage. Or it may be fed green, for it is, without exception, the best soiling crop for dairy cows.

Not only as hay and silage but also as pasture alfalfa yields large returns. It may best be pastured in the fall after the last crop has been cut, but should not be grazed very closely. It furnishes the best of pasture for hogs, horses and poultry, and for these animals it is perfectly safe. Sheep and cattle should be gradually accustomed to pasturing on alfalfa, since otherwise they may become bloated.

A TON OF PROTEIN PER ACRE.

In New Jersey an experiment was made in substituting alfalfa for wheat bran, dried brewers' grains and cottonseed meal for cows. A slight diminution in the milk yield was noted when the change was made from grains to alfalfa, but the cost of production was reduced to the extent of 2.3 cents per pound for butter and 12.7 cents per 100 pounds for milk. The actual effective



A yearling alfalfa plant.

feeding value of alfalfa proved to be $74 per acre. The expensiveness of nitrogenous grain feeds is the greatest drawback to modern dairy farming. Alfalfa, however, produces more than a ton of protein per acre each year. All dairymen should therefore give it a thorough trial, since it so greatly reduces the expenditure for grain feeds. Subsequent experiments have dem-

onstrated that with milk at $1 per 100 pounds the feeding value of alfalfa is nearly $120 per acre. In one test where alfalfa hay was substituted for grain there was a gain of 314 per cent. over the cost of production. Similar results have been obtained from Louisiana to New York, and everywhere alfalfa has proved to be a crop without an equal for milk production.

ITS WONDERFUL FEEDING VALUE.

For horses alfalfa hay sometimes proves too rich, and in such cases straw or timothy may be mixed with the alfalfa. Nevertheless there are hundreds of horses kept at hard work for months at a time without loss of weight or condition and on an exclusive ration of alfalfa hay. When fed to sheep alfalfa increases the yield of wool and produces the best quality of mutton. For this purpose it is superior to red clover and better relished by sheep and lambs. Hogs also thrive on a diet of alfalfa. Several instances are known to the writer where hogs are raised on it without grain and with a handsome profit. From time to time the hogs should be changed from one field to another or shifted about by temporary fences so as to prevent injury to the alfalfa. One agricultural experiment station recommends that "alfalfa should form part of the daily ration of every growing pig."

In the production of beef one pound of alfalfa is equal to three pounds of corn silage, including the ears. On account of the high protein content of alfalfa it makes, in combination with corn, the cheapest and most effective ration for beef. Alfalfa is likewise an unexcelled green feed for chickens, ducks, geese and turkeys.

Like other common legumes, alfalfa may become inoculated with nitrogen-gathering bacteria and the nodules thus formed on the roots collect nitrogen from the air and add fertility to the soil. The yield of crops grown after alfalfa is greatly increased. The yield of wheat is thereby increased $8 to $12 per acre; oats, $16; potatoes, $16. The value of alfalfa in a system of crop rotation thus becomes apparent. As a rule, however, it is not much used in short rotations, since it maintains itself for years without diminution of yield. On account of the enormous crops which alfalfa produces and its high feeding value the farmer can well afford to raise it in the place of clover even if it is plowed up every two years. In Ohio a two-crop rotation has been suggested, including alfalfa for four years, followed by corn for one year.

A PARALLEL: ALFALFA VS. CLOVER.

Alfalfa is ready for cutting a full month before red clover. There is a strong advantage in dairy farming, since green crops are needed at the earliest possible moment in the spring. After cutting, alfalfa springs into growth more promptly than clover and a second crop is produced within six to eight weeks. Clover lasts two years and alfalfa ten to thirty years. In New Jersey the average yield of green forage per acre was 36,540 pounds for alfalfa and 14,000 pounds for red clover. The weights of dry hay were 8,258 pounds and 4,088 pounds, and of protein 2,214 pounds and 616 pounds per acre, respectively. In the same State alfalfa was found to contain 1,809 pounds of dry matter and 265 pounds of protein per ton as compared with 1,694 pounds

and 246 pounds for clover. In other words, alfalfa not only yields two and one-half times as much as red clover, but its feeding value is greater pound for pound.

Alfalfa is far past the experimental stage in the Eastern States. Winter killing of alfalfa sometimes occurs in Northern New York and Massachusetts, but clover and timothy are destroyed by the same cause. Its fungous and insect enemies are not so serious as those of clover. Alfalfa has come to stay with the Eastern farmer and will increase in acreage and importance.

E. V. WILCOX.

"Courtesy Country Life."

Adulteration of Alfalfa and Red Clover Seed.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

Seeds of alfalfa and red clover have been obtained and tested in accordance with the following paragraph contained in the act of Congress making appropriations for the Department of Agriculture:

The Secretary of Agriculture is hereby directed to obtain in the open market samples of seeds of grass, clover, or alfalfa, test the same, and if any such seeds are found to be adulterated or misbranded, or any seeds of Canada bluegrass (*Poa compressa*) are obtained under any other name than Canada bluegrass or *Poa compressa*, to publish the results of the tests, together with the names of the persons by whom the seeds were offered for sale.

In carrying out the provisions of this act, 1,272 seedsmen were asked by special agents of this Department for samples of red clover and alfalfa seed, as offered for sale by them. From these seedsmen, 658 samples were obtained and examined. As a result, the following lots were purchased in the open market and found to be adulterated. In accordance with the mandatory nature of the act quoted above, publication is here made of the names and addresses of the seedsmen who sold the lots found to be adulterated, together with the percentages of adulteration in each lot.

Results of tests of samples bought in the open market as red clover seed and found to be adulterated.

Seed sold as red clover by—		Seeds used as adulterants.	
Name.	Address.	Yellow trefoil.	Total adulterants.
		Per ct.	Per ct.
Rawson & Co., W. W	12 and 13 Faneuil Hall Square, Boston, Mass	10.55	10.55
Ross Bros	90 and 92 Front street, Worcester, Mass	26.85	26.85
Small & Co., W. H	7 and 9 Upper First street, Evansville, Ind	14.08	14.08

Results of tests of samples bought in the open market as alfalfa seed and found to be adulterated.

Seed sold as alfalfa by—		Seeds used as adulterants.			
Name.	Address.	Sweet clover.	Bur clover.	Yellow trefoil.	Total adulterants
		Per ct.	Per ct.	Per ct.	Per ct.
Barrett Co., The W. E.	65-87 Canal street, Providence, R. I		3.47	32.86	36.33
Barteldes & Co	1521 Fifteenth street, Denver, Colo		16.86		16.86
Crossman Bros	508 Monroe avenue, Rochester, N. Y		5.02	39.48	44.50
Dallwig, W. E	34 Juneau avenue, Milwaukee, Wis		5.74		5.74
Everitt, J. A	227 W. Washington street, Indianapolis, Ind.		4.27	38.43	42.70
Do	do		3.90	39.53	43.43
Gregory & Son, James J. H.	Marblehead, Mass		3.00		3.00
Grossman, W	15 Bollingbrook street, Petersburg, Va			1.25	1.25
Hamilton Bros	Cedar Rapids, Iowa		5.49		5.49
Huntington & Page	130 E. Market street, Indianapolis, Ind		3.37	38.54	41.91
Kirchner, Jacob F	156 North street, Pittsfield, Mass	9.52			9.52
McMillan Seed Co. L. D.	25 S. Broad street, Atlanta, Ga		10.04		10.04
Martin, B. E	Main and Walnut streets, Salem, Ill			6.98	6.98
May & Co., L. L	381 and 383 Minnesota street, St. Paul, Minn.			31.77	31.77
National Seed Co	101 W. Main street, Louisville, Ky		16.53		16.53
Platt Co., The Frank S.	374 and 376 State street, New Haven, Conn.		5.88	39.85	45.73
Rush Park Seed Co	Independence, Iowa		12.69		12.69
Steckler Seed Co., Ltd., J.	518-526 Gravier street, New Orleans, La		2.57	.63	3.20
Young & Halstead	Foot of Grand street, Troy, N. Y		6.23	31.26	37.49

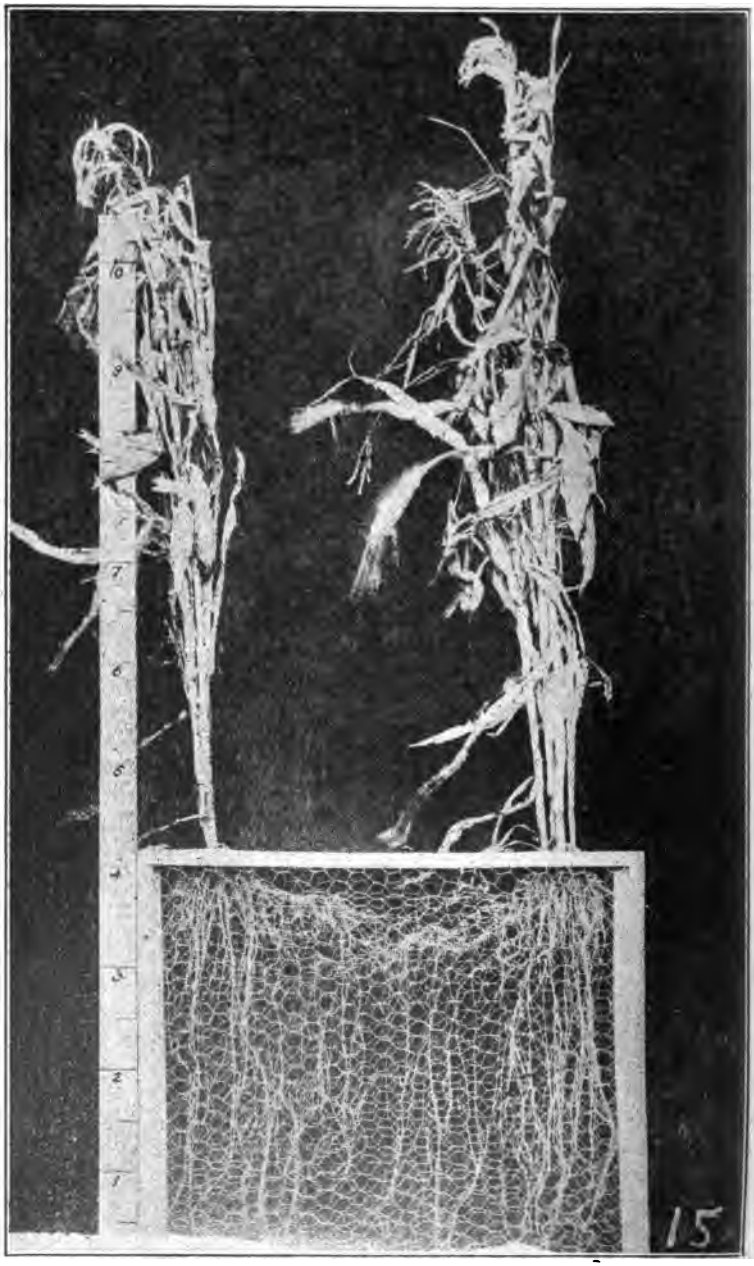
In order to aid seedsmen in avoiding the purchase of adulterated seeds, this Department will examine and report promptly as to the presence of adulterants in any samples of seed submitted for that purpose.

JAMES WILSON,
Secretary of Agriculture.

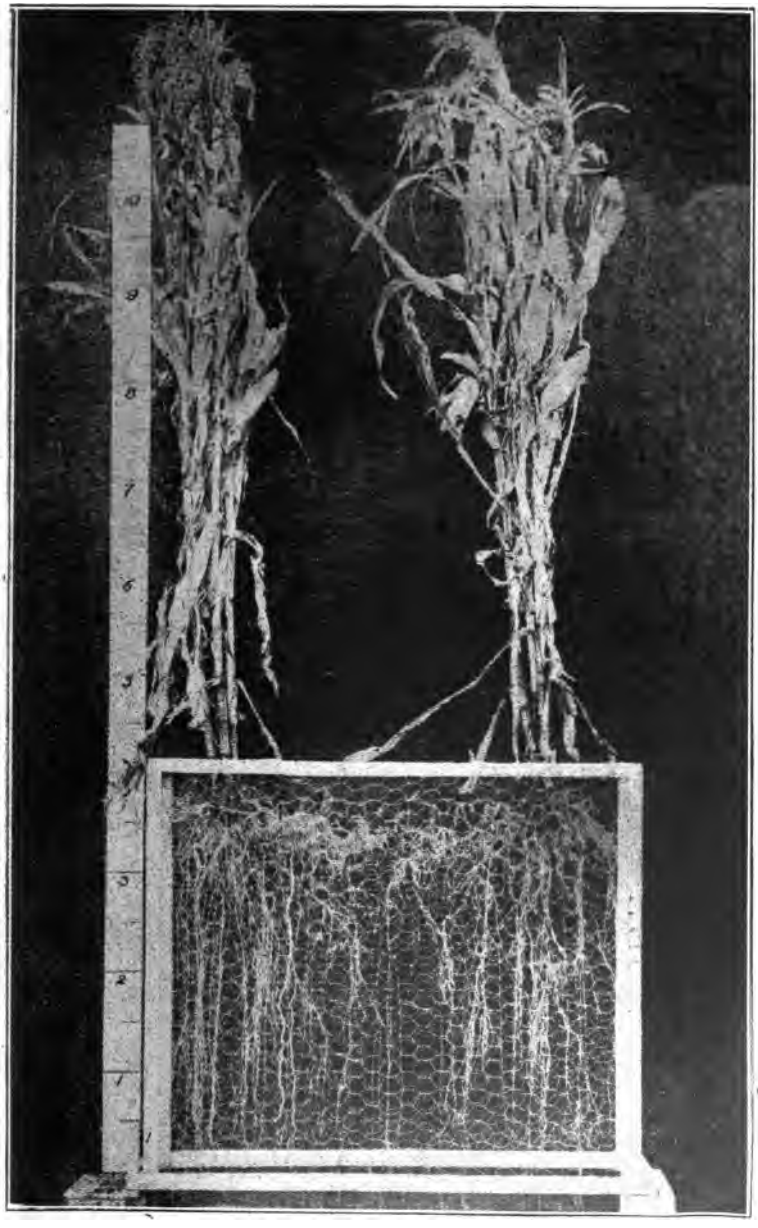
WASHINGTON, D. C.

The Root Systems of Field Crops.

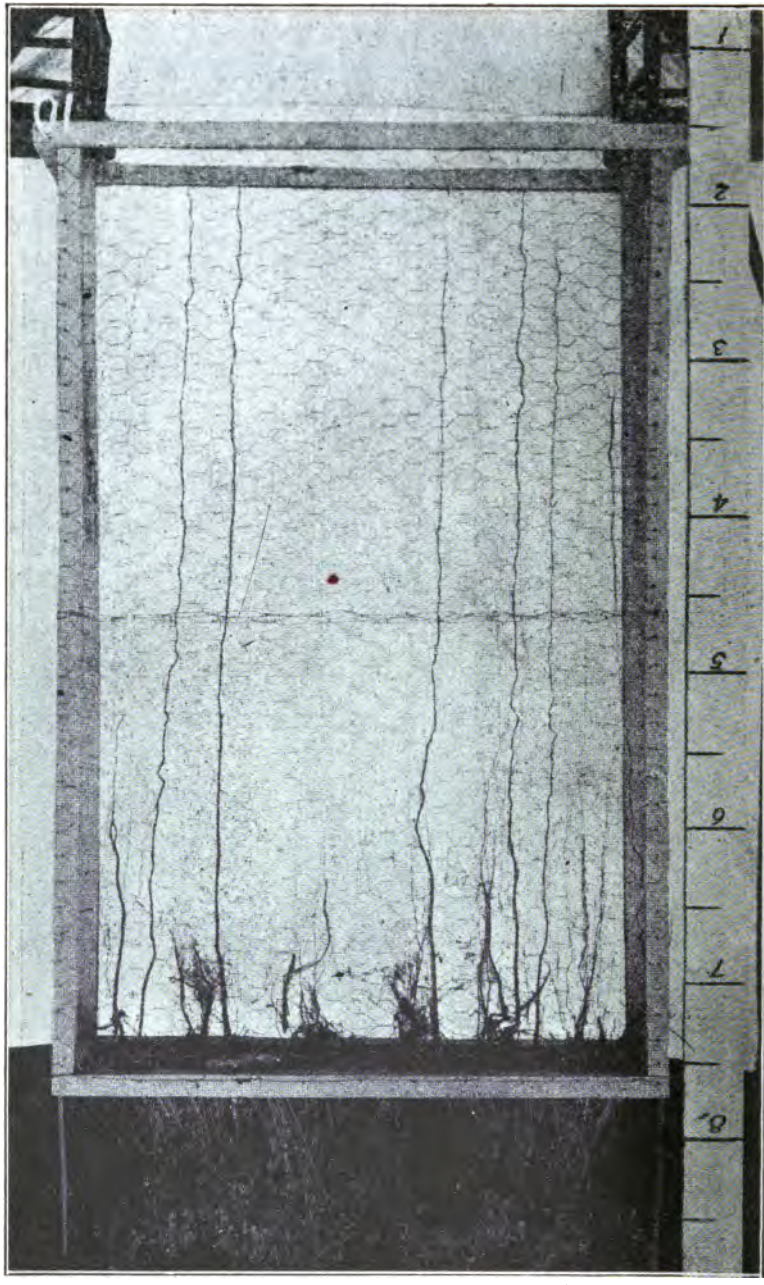
The root systems of our cultivated plants bear a most important relation to the cultivation of the crops, the application of fertilizers, and the moisture content of the soil; and in order to understand fully the reasons for the different cultural practices it is really necessary to know to what extent and in what way the roots of the various crops develop. That the development of the root systems of our common cereal and forage crops is not so well understood as might be supposed is demonstrated by the fact that samples of plants prepared with a view to showing the lateral as well as the downward extension of the entire root system in its natural position always arouse great interest in observers of all classes, and even cause surprise to persons who have spent their whole lives upon the farm, and in many cases growing those very crops year after year. Such samples were exhibited at the World's Fair in Chicago in 1893, in Paris in 1900, and in St. Louis in 1904, and in every instance they proved to be most instructive object lessons.



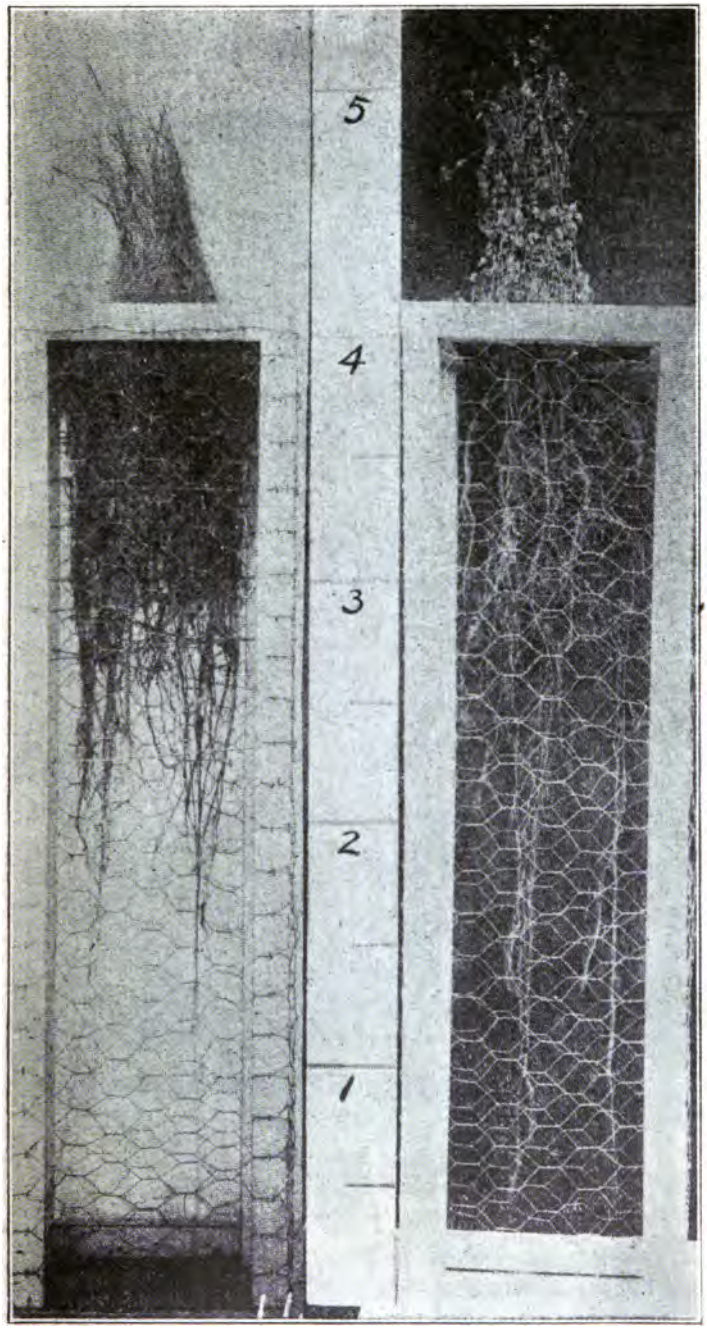
Corn roots at maturity planted in check and level cultivation.



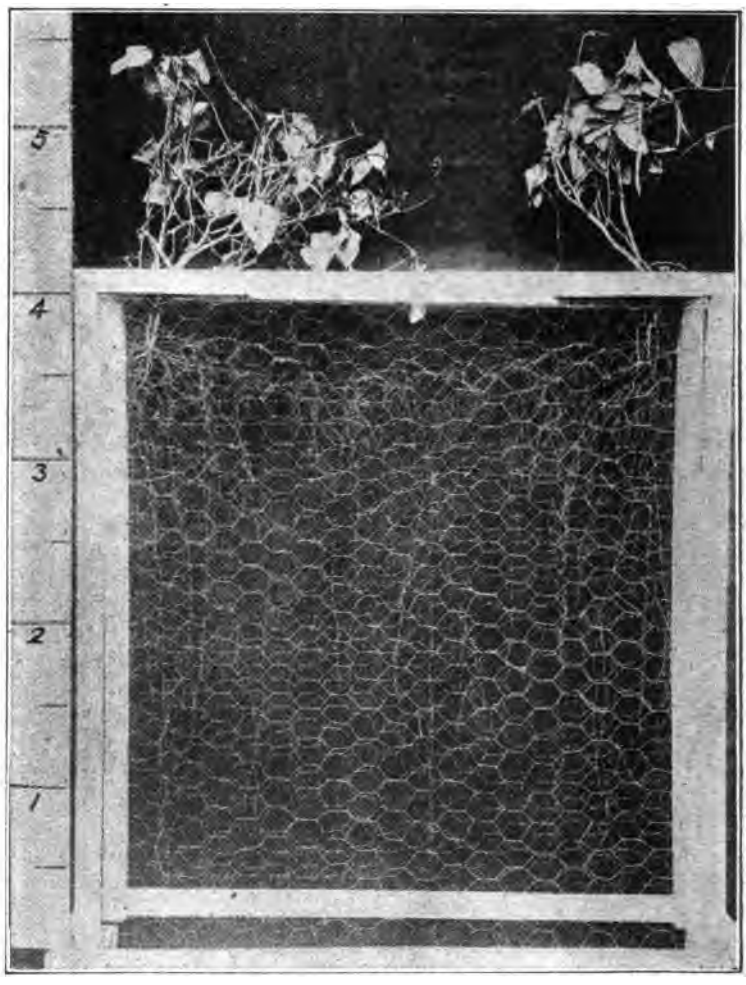
Corn roots at maturity, planted in lister rows.



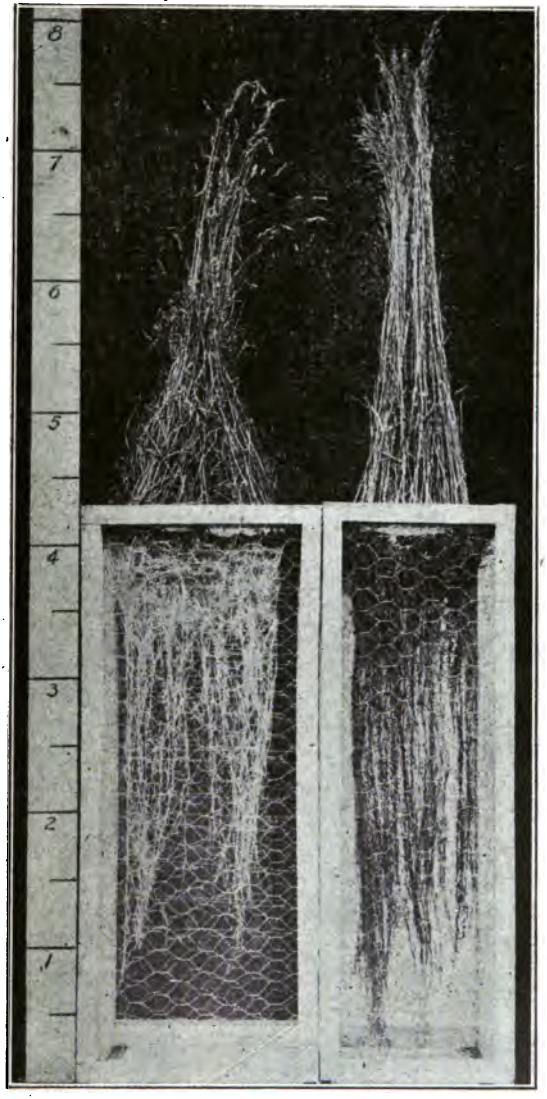
Alfalfa roots three years old.



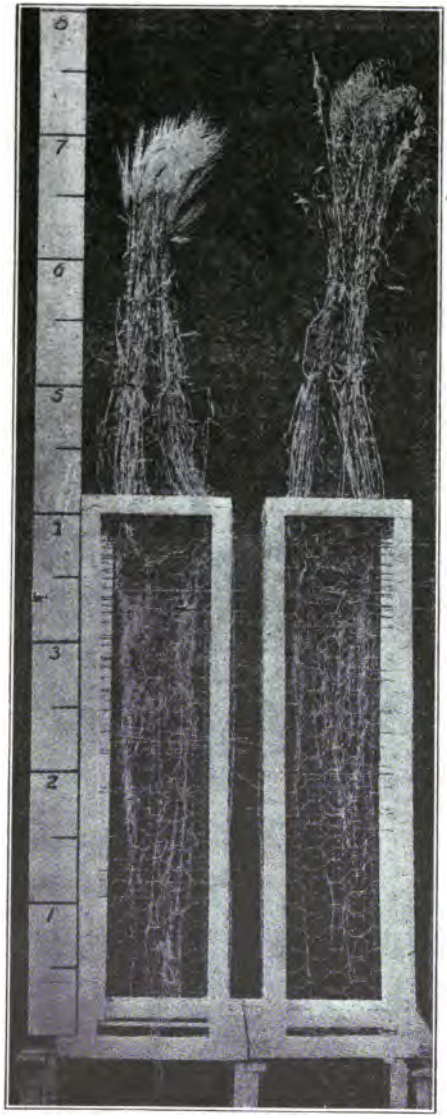
Kentucky blue grass roots. Red clover roots.



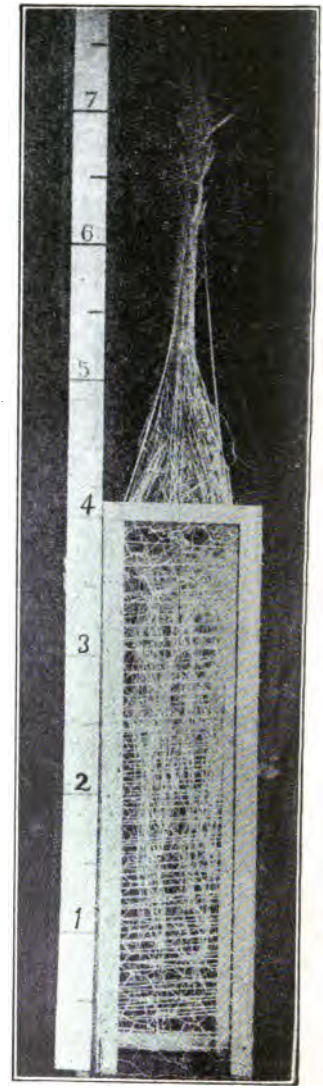
Showing the roots of cowpeas 100 days after planting.



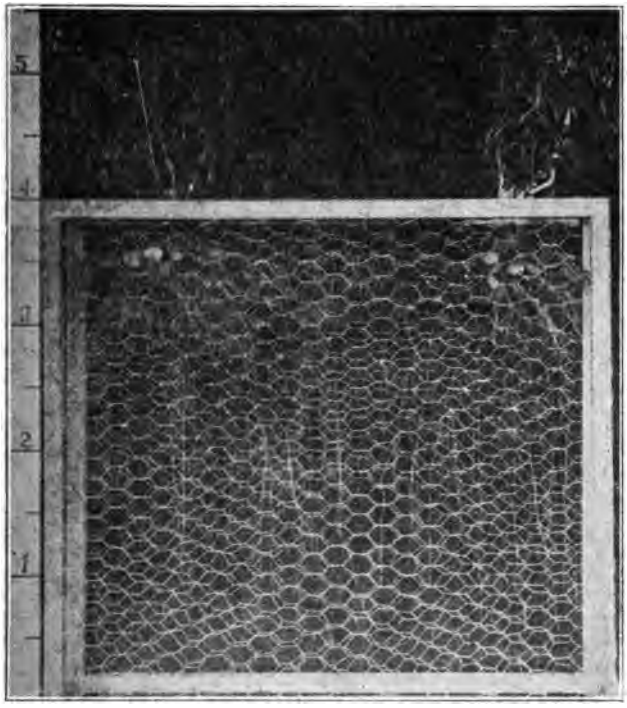
Orchard grass roots. Brome grass roots.



Barley roots. and oat roots.



Wheat roots.



Roots of late potatoes 90 days after planting.

Live Stock.

Wintering Cattle on Sorghum in King William County.

The accompanying cut describes the large sorghum crop grown on the "Towringen" plantation of Mr. Peter Paul and his stock which he winters on the sorghum hay made. This plantation is twenty-two miles east of Richmond, on the north side of the Pamunkey river, in King William county. The crop is now piled up in cocks on one hundred and twenty acres in a single field, besides other small fields. His herd consists of 400 head of stock cattle, all raised on the plantation. There is also this year a field of corn one hundred and sixty acres now shocked up to dry out by the freezing and to be shucked and shreded for feeding dry in racks, besides two hundred acres of corn already cut up in the green state and packed away in silos, which will be fed with corn cob meal. Mr. Paul farms in a practical way. He does not try to make a show to the world, but lets his works show for themselves. Those who come in contact with Mr. Paul, who is actively engaged in the sale of mules in the city of Richmond, know nothing of his owning this large estate and all of these fine cattle and young horses that are to be seen on his plantation. Mr. Paul sold last winter one hundred fat cattle, ninety-seven of them three-year-old steers and three-year-old heifers, for $5,000. All of these cattle were raised on the plantation. Mr. Paul is now getting his herd well graded with Herfords, which, after five years' experience, he thinks are the best cattle for this section of Virginia. All the heifer calves are kept to breed from. Mr. Paul has learned from experience that sorghum is the best hay to raise for his cattle, as it can stand out in cocks all the winter and will keep as well there as it will in barns. This saves the extra expense of rehandling it.

Mr. O. B. Pollard, Mr. Paul's general manager, says two bushels of sorghum seed to the acre is about right, which keeps it from growing too stalky. Mr. Pollard also says that he only seeded a few acres five years ago, and has made the crop larger each year, and that the crop this year will average five tons of dry hay to the acre. A certain number of acres is seeded in rows three feet apart to make the seed. From this land twenty-five to fifty bushels of seed are gathered and threshed for seed for the coming year. The crop is seeded broadcast and put in with a disc cultivator when the land has been plowed some time previous, but when it is fresh plowed a light harrow is used. Mr. Pollard says the colts are fed on sorghum hay all winter without grain, and come out in the spring in fine condition. Sorghum hay will not get muskey like other hay, and when small lots lay out thin on the ground for three months stock will eat it better than they will any other kind so exposed for same length of time.

P. H. EUBANK.

One Hundred and Fifty Acres of Sorghum Hay on Mr. Peter Paul's Farm, Hanover County.

Feeding Experiments.

WEIGHT PER QUART OF FEEDING STUFFS.

The quart is the measure generally used on the farm, and especially in connection with measuring the rations of concentrated feeds for farm animals. Since such rations can be more accurately stated in terms of actual weight and are always so stated in the more scientific discussions of the subject, it is important to know the weight per quart of the feeds most commonly used. The following table of such weights is given in a recent bulletin of the Massachusetts Experiment Station. This table was prepared by weighing a carefully measured quantity of the several feeds:

Average weights of different feeding stuffs.

Feeding Stuff	One quart weighs—	One pound measures—
	Pounds.	*Quarts.*
Barley meal	1.1	0.9
Barley, whole	1.5	.7
Brewers' dried grains	.6	1.7
Corn-and-cob meal	1.4	.7
Corn-and-oat-feed	.7	1.4
Corn bran	.5	2.0
Corn meal	1.5	.7
Corn, whole	1.7	.6
Cotton-seed meal	1.5	.7
Distillers' dried grains	0.5-.7	1.0-1.4
Germ oil meal	1.4	.7
Gluten feed	1.3	.8
Gluten meal	1.7	.6
Hominy meal	1.1	.9
Linseed meal, new process	.9	1.1
Linseed meal, old process	1.1	.9
Malt sprouts	.6	1.7
Mixed feed (bran and middlings)	.6	1.7
Oat feed (a variable mixture)	.8	1.3
Oat middlings	1.5	.7
Oats, ground	.7	1.4
Oats, whole	1.0	1.0
Rye feed (a mixture of rye bran and rye middlings)	1.3	.8
Rye meal	1.5	.7
Rye, whole	1.7	.6
Wheat bran	.5	2.0
Wheat, ground	1.7	.6
Wheat middlings (flour)	1.2	.8
Wheat middlings (standard)	.8	1.3
Wheat, whole	1.9	.5

A bulletin of the Connecticut State Station gives in addition to the above—mixed wheat feed, 0.6 pounds per quart; provender, 1.5 pounds; rye bran, 0.6 pound.

SUGGESTIONS REGARDING GRAIN RATIONS.

In a recent bulletin of the Massachusetts Agricultural Experiment Station, J. B. Lindsey makes the following practical suggestions regarding grain rations:

Concentrated feeds differ from roughage in two important particulars: First, all concentrates contain more true starch and less woody fibre, and con-

sequently are more digestible; secondly, most of them contain more protein. The object, therefore, of feeding concentrates is to increase both the total digestible matter and the amount of protein in the daily ration.

It is better to use two or three grains in making a ration than to feed one concentrate exclusively, and the feeder should aim to prepare palatable grain mixtures. Rations should be bulky, to avoid digestive disturbances. Many feeders use from one-third to one-half wheat bran in order to obtain the necessary bulk. Distillers and brewers' dried grains and malt sprouts likewise serve as economical bulky feeds. It is also possible to use corn silage and chopped hay as diluters or distributers of the heavy concentrates.

If bran is used as a base, a very good type of ration may consist, by weight, of:

(1) 1-3 bran, 1-2 gluten feed, and 1-6 cotton-seed meal.
(2) 1-3 bran, 1-3 cotton-seed meal, and 1-3 corn meal.
(3) 1-3 bran, 1-3 gluten meal, 1-3 flour middlings.
(4) 1-2 bran, 1-2 gluten feed.

One may use dried distillers' grains for bulk and also as a source for protein, mixing by weight:

(1) 1-2 distillers' grains, 1-4 flour middlings, 1-4 corn meal.
(2) 1-2 distillers' grains, 1-6 cotton-seed meal, and 1 3 corn meal.

Malt sprouts, also a bulky feed, can be used, mixed with other grains, by weight, as follows:

(1) 1-4 malt sprouts, 1-4 mixed feed, 1-2 gluten feed.
(2) 1-5 malt sprouts, 2-5 cornmeal, 2-5 gluten feed.

It is better to prepare a considerable amount of the above mixtures at one time, and then feed a definite quantity each day.

In case corn silage is used as a distributer, the mixture may consist, by weight, of:

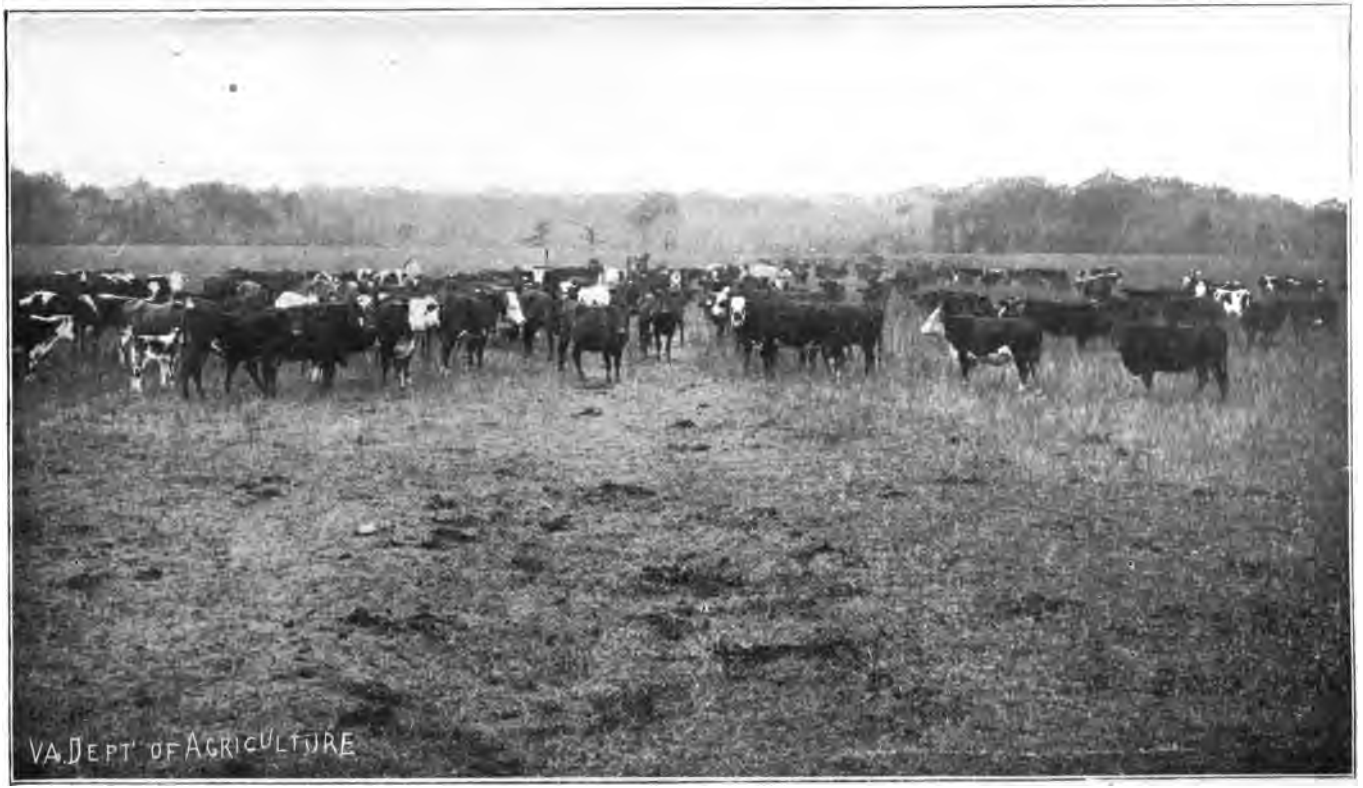
(1) 1-3 cotton-seed meal, 1-3 flour middlings, and 1-3 corn meal.
(2) 1-2 corn meal, 1-4 cotton-seed meal, and 1-4 oat middlings or rye feed.

Care must be taken to see that such combinations are well mixed with the silage.

Seven pounds is the usual quantity to be fed daily to cows producing ten to twelve quarts of milk. The richer the milk the more food needed. Because of the high prices of concentrates, and in localities where there is not a quick demand for milk, many feeders may find it economy to use but five pounds of grain daily, and feed maximum amounts of roughage. Heavy milking Holsteins generally require from ten to fourteen pounds of grain daily, depending upon the milk yield.

It is hardly possible to advise dairymen which ration would prove the most economical, as prices are likely to change so quickly.

Only general suggestions can safely be made, and these must be supplemented in any case by a study of the markets and the exercise of good judgment on the part of the practical feeder in order to get the most economical as well as effective ration.



Stock Cattle Wintered on Sorghum Hay in Hanover County.

RECENT HORSE-FEEDING TESTS.

A ration of oats and hay of good quality is generally recognized as a standard in horse feeding and is considered by many feeders indispensable for fancy stock if the best results are to be secured. Nevertheless, in different regions a variety of feeding stuffs are used for horse feeding, and it is true, especially for work animals, that the character of the ration fed is very largely determined by the local food supply. In recent years a number of the experiment stations have carried on investigations which have to do with the value of different feeding stuffs for horses and the ways in which they may be best combined to secure a high degree of efficiency at a reasonable cost, and a popular summary of such work has been published by this Department. Some additional investigations along the same lines are also of interest.

C. W. Burkett, at the North Carolina Experiment Station, made an extended series of studies with farm horses and mules, for the purpose of comparing local-grown feeding stuffs with each other and with purchased feeds, the tests being, in general, so arranged that the rations compared were fed at the same time to each of a pair of animals performing like work under uniform conditions. The principal feeding stuffs studied were bran, cowpea hay, gluten meal, corn-and-cob meal, shelled corn, corn silage and stover, cowpeas, cotton-seed meal, animal meal, and blood meal, a total of fifty-nine rations being tested. During the tests the weights of the animals were taken weekly and the number of work hours recorded. The conclusion was reached that the home-grown forage crops under consideration are adapted to horse feeding, and by their use the purchase of feeds may be reduced to a minimum. Cowpea hay is considered a valuable feed for horses. Combined with corn-and-cob meal it makes a satisfactory working ration and can also be substituted for bran and oats, provided a reasonable quantity of corn is also fed. Two mules weighing about 1,000 pounds each maintained their weight for a period covering about two months on a ration of 10 pounds of cowpea hay, 1.5 pounds of cotton-seed meal, and 15 pounds of corn-and-cob meal, the average cost per day being 19.5 cents.

Corn silage proved a superior feed for horses and mules, one of the most satisfactory rations in the series of tests being made up of 21 pounds of silage, 15 pounds of corn, 2 pounds of bran, and 1 pound of cotton-seed meal. Corn stover was also shown to be an exceedingly valuable feed for farm horses and mules, and the author considers it a good substitute for hay in winter on account of its feeding qualities, high yield per acre, and low market value. Oat hay, cut while in the milk stage, was also found to be a satisfactory feed. When thus harvested it compared favorably with clover hay and cowpea hay.

Considering the nutrients supplied per pound, cotton-seed meal was found to be a relatively cheap feed, and its utilization is spoken of as a matter of great importance, especially for Southern farmers. In the North Carolina experiments cotton-seed meal formed a part of the ration in a number of cases, in general with good results, though some of the animals did not at first relish it. The author states that "two pounds of cotton-seed meal, as a part of the daily rations, was fed to horses and mules with satisfaction. This quantity can be fed either in a mixture with grain or sprinkled on silage or on hay or stover that has been moistened previous to feeding. In com-

parison with other feeding stuffs, cotton-seed meal, because of its high feeding value, is a relatively cheap feed. Corn stover, corn, and cotton-seed meal, because of feeding and commercial values, make satisfactory rations for winter feeding of horses and mules, or at other times when on light or moderate work.

In some of the tests tankage and dried blood were fed, the results as a whole being satisfactory. The dried blood is regarded as especially valuable where horses are run down or thin in flesh. In the case of tankage one or two pounds was fed per day and in the case of dried blood one pound.

As regards the comparative value of different cereal grains and by-products, bran was found to be an acceptable and satisfactory substitute for oats and corn, and in the author's opinion it should always find a place in the ration of work horses where it can be obtained at a moderate cost. The animals fed corn-and-cob meal showed the same efficiency in work and maintained their weight as well as those fed an equal quantity of shelled corn.

When corn on the ear was compared with an equal quantity of corn-and-cob meal, corn stover being used as a coarse fodder, the results were in favor of the ground grain. When clover was used as a coarse fodder there was practically no difference in the two rations. In general it appears that the advisability of grinding corn will depend upon the cost of labor and trouble involved in the operation.

When wheat and cowpeas were compared as part of a ration the cowpeas were considered equal to the wheat or possibly somewhat superior, and, in the author's opinion, are a satisfactory substitute for oats in feeding farm horses and mules. In a test in which cowpeas and oats were compared 4 pounds of each of these feeds were added to a basal ration of 4 pounds of ground wheat, 4 pounds of corn-and-cob meal, and 14 pounds of meadow hay, the cost of the oat ration being 24.4 cents and of the cowpea ration 20.4 cents. In the two weeks of the test the horses had each gained a little in weight and, judged by their appearance and condition, the two rations were equally satisfactory.

From his work as a whole the author concludes that "various kinds of feeding stuffs can be used to advantage and with economy in feeding farm horses and mules. There is no so-called 'one ration for horses.' A mixture of corn and bran, or of corn and cowpeas, or of corn, bran, and cotton-seed meal, is a good substitute for corn and oats in feeding work animals. Any feeding stuff or combination of feeding stuffs that furnishes the necessary and desirable nutrients at least cost should be the important consideration in the preparation of rations for farm hores and mules."

At the Indiana Station, C. S. Plumb compared a brand of dried distillers' grains with oats as a feed for horses. Marked differences were noted in the quantity of the distillers' grains eaten, in one of the tests the average amount being about seven pounds per head per week with one pair of animals as compared with about thirty-two pounds per head with another pair. The amount of oats eaten ranged from about seventy-six to ninety-four pounds per head per week. It was always found necessary to accustom the horses to the distillers' grains by adding them in increasing amounts to the oat ration. In a second test much the same differences were observed in the amounts of distillers' grains eaten, this feed being so little relished that the quantity consumed by the horses would not have sufficed for the performance of their or-

dinary work unless other and more palatable feeds had been supplied. In brief, the conclusion was reached that the distillers' grains tested are not palatable horse feed, although judged by their chemical composition they possess a high feeding value. The investigation "simply illustrates the special importance of palatability as a factor in the adoption of food stuffs for use in common practice."

The use of sweet potatoes, cassava, and cane sirup as partial substitutes for corn in a ration for horses and mules was studied by C. M. Conner at the Florida Experiment Station. In the test with sweet potatoes two pairs of horses and two of mules, doing hard work, were used, one animal of each pair being fed approximately 6 pounds of corn, 17 pounds of hay, and 15 pounds of sweet potatoes per 1,000 pounds live weight, and the other some 10 pounds of corn and 15 pounds of hay per 1,000 pounds live weight, the hay used being beggar weed of good quality. After about six weeks the rations were reversed. Little variation in the weight of the animals was observed, except that in some cases there was a gain when sweet potatoes were fed. The sweet-potato ration was cheaper.

The most important fact brought out in this experiment is that sweet potatoes may be substituted for at least one-half of the corn ration, this substitution being at the rate of three pounds of sweet potatoes for one of corn. This being the case, an acre of sweet potatoes yielding 150 bushels is equal to a yield of fifty bushels of corn, so far as feeding the work stock is concerned. We do not think that a horse at hard work would do well on all sweet-potato ration, from the fact that the bulk would be too great for the capacity of the stomach.

Winter Lambs.

The photograph of "hot-house" lambs shown on accompanying page by Geo. M. Wilber, who makes a specialty of rearing early lambs, which he ships to Baltimore, Philadelphia and New York, realizing fine prices. In an address delivered before a meeting of the Live Stock Association, Mr. Wilber gave a brief outline of his methods, some of the principal points being as folows:

He thinks the best ewes are none too good, and while he wants good individual rams, he cares little for pedigree; in fact, he made a strong statement in favor of using crossbred rams for early lambs. He also advocates fat ewes at lambing and does not want exercise. He says he knows he will be regarded as a sinner by some, but this is his opinion after breeding thousands of ewes for years. The kind of fat he wishes, however, is the sort from grass, oats, bran, etc. He prefers a mixture of corn, oats, and bran in equal parts for grain, and favors alfalfa or clover hay, but never timothy for sheep. He is trying silage this season for the first time, with a reserved opinion as yet on its merits, giving it to 300 suckling ewes. When the ewes go to the barn they are sorted into pens of 40 to 100 each, grading according

to flesh and type, and allowing about six feet square to each ewe, with one foot of barn rack. Twelve feet is his standard width of pen.

When the lambs come they with the dams are separated from the flock and placed in an inclosure by themselves. Then the lambs are watched for a few days to see if they nurse well and the ewes are all right and the udders in good shape until a pen is filled. If a ewe has twins she is placed in a

Shipping a car load of winter lambs.

small pen by herself and young for a few days. When taken out she and the lambs are given a twin mark and special care. The feed of the ewe should be increased, and when the lambs are ten days old they begin to lick a bit of bran and pick clover, and soon will begin to eat cracked corn, which is the best of foods for fattening lambs. He has "hot-house" lambs at five weeks old of sufficient size and quality for the very highest New York prices.

A Successful Ensilage Feeder.

Mr. J. R. Kemper, of Augusta county, has been feeding ensilage for several years with gratifying results. Last winter Mr. Kemper fed a lot of sixty head of cattle on corn ensilage. The cattle improved all of the winter and

were put on grass the first of May and were sold in September at five cents per pound for export. The lot averaged 1,410 pounds. Mr. Kemper is feeding a larger number of cattle this winter on ensilage and is pleased with this kind of feed.

Mr. Kemper's silos and cattle.

Fruit Growing.

Virginia Apples and Peaches.

BY S. B. WOODS, PRESIDENT VA. STATE HORTICULTURAL SOCIETY.

The apple crop of Virginia for 1905 has brought a great deal of money to the State and should encourage the growers of fruit and those contemplating planting new orchards. Virginia is not only noted for the high quality of the fruit grown, but for the reliability of her orchards, their steadiness in bearing and their longevity, while in the West an orchard does not last longer than twenty or twenty-five years. In Virginia there are many orchards still in useful bearing at seventy-five and eighty years of age. Some trees are known to have borne large crops of fine quality when over 100 years of age.

From Frederick county about $200,000 worth of apples have been shipped, the growers getting from $1 to $2 per barrel in the orchard. Hon. S. L. Lupton, from a young orchard of forty acres, got $7,160 in the orchard. From Covesville, in Albemarle county, where the highest priced apples are raised, 44,000 barrels were shipped, bringing from $3 to $6.75 per barrel net. Dr. S. A. Robinson, near Covesville, received from $5 to 6.75 net per barrel for his apples. All the first-class apples from this section are shipped direct to the English markets. A letter to Dr. Robinson from England states that his apples are superior to any apples received this season in the English markets and have topped the market in price exceeding that paid for the best Orgeon fruit. Mr. Goodwin, of Nelson, had 1,800 barrels of fine apples, worth $3.50 in the orchard. Rappahannock, always producing apples of high quality, has done well this year, as has Augusta, Patrick, Bedford and a number of the Valley, the Piedmont and other sections. At this writing it is impossible to give exact figures, but the apple crop of Virginia this year can be safely estimated at a good many millions of dollars.

Virginia peaches, too, have done well this past season, doing almost as well, in some localities even better than the apples. A Mr. Ballard, of Crozet, it is stated on good authority, made on an acre and a half of peaches $1,200. This is the best yield and the best return that has been reported. Virginia has a great advantage in her proximity to New York, the great distributing market, for peaches put on the train in the evening reach New York by six o'clock the next morning, making the trip in less than twelve hours. The Albemarle Orchard Company made some trial shipments of peaches to London this fall and were quite successful, the fruit carrying well and netting a dollar a bushel more than the prices paid in New York.

There is a grand future for the fruit business of Virginia. It needs only patience, perseverance and the application of business methods in the orchard and in the markets to gain a reward greater than any other agricultural investment in the United States can offer.

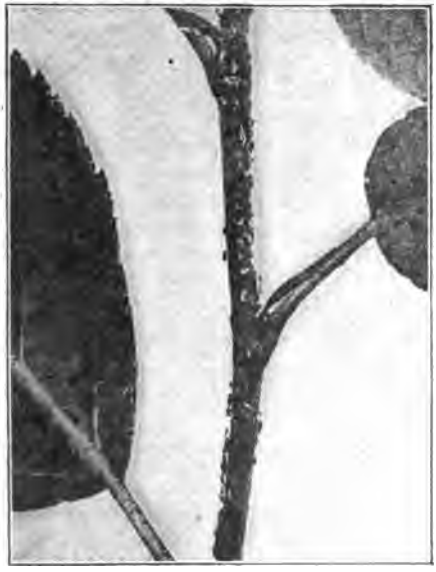
Apple Crop Sold for $475.00 Per Acre, Season 1905, by Mr. A. H. McCue, Augusta County.

THE VALUE OF AN APPLE TREE.

Where apple trees have been destroyed by railroad lines a schedule of values have been generally adopted by putting a value of $1 per tree for each year up to ten years old; that is, a tree set one year is worth $1, a tree two years old is worth $2, and so on up to ten years. There are many orchards in Virginia this year that made a large dividend on higher values per tree than this schedule. Some crops have made over $400 per acre, and the trees are ready for another year's business.

Plant Lice or Aphids.

There are more than three hundred kinds of plant lice known in this country, feeding on nearly all our common plants, shrubs and trees, and the injury they cause is often serious. They begin their work early in spring, often before the plants they are upon have gotten well started, and increasing in numbers with great rapidity do a great deal of damage almost before it is realized that they are present.



Plant Lice or Aphids.

Among the more important plant lice which concern the fruit grower and farmer are the woolly apple louse, so noticeable along scars of the limbs of apple trees in the fall, because of the white woolly threads it forms; the green apple louse; the black louse on plum and cherry; the cabbage louse; the currant louse; the rose louse; the pea-vine louse; and during the spring of 1903 the elm louse and maple louse.

The life history of some species of these insects is quite different from that of others, so that only general statements for the group as a whole can be made.

As a rule plant lice pass the winter in the egg stage, the eggs being attached to the stem or twigs of the food plant. In the spring the eggs hatch and the tiny aphids, which are green, brown or black, soft-bodied, wingless forms with six legs, begin to feed, sucking the juices from the twigs or leaves. This is done by means of a pointed beak, the tip of which is pushed through the bark or epidermis till it reaches the sap. In the course of a few days

each little aphid becomes adult and begins to produce living young at the rate of three or four nearly every day. These in their turn feed, grow, and reproduce, and in this way many generations appear during the summer. One or more of these generations may develop wings and pass to other plants, in this way spreading over the entire region. In the fall the last generation does not produce living young, but lays eggs instead, and these winter over, hatching the following spring.

The rapidity with which plant lice increase is of importance, as but a short time is required after the first individuals appear for a plant to swarm with them, and when this occurs treatment becomes more difficult. This is because in many cases the effect of their feeding is to cause the leaves on which they are to curl, thus protecting the lice so that they cannot be reached by a spray.

Plant lice produce a sweet, sticky fluid known as honey dew, from two small tubes on the upper side of the body, and ants are very fond of this, visiting the lice and gathering it from them. If the honey dew falls on the leaves and twigs it makes them sticky, and it is sometimes produced so abundantly as to fall to the ground with a pattering sound like rain. This substance forms an excellent place for the growth of fungus, which turns the honey dew black, and accounts for leaves and twigs having a smutty appearance, particularly in the late fall and early spring.

Treatment.

As plant lice suck plant juices, no poison like Paris green or arsenate of lead is of the slightest value, and something that will destroy these insects by touching them is necessary. Such a substance is kerosene emulsion, which kills by covering the body of the insect with a thin film of oil and suffocating it. In order to obtain good results with this material, however, it is necessary to touch every individual, which it is exceedingly difficult to do, even when the insects are not protected by the curling of the leaves, because of their small size. To treat for plant lice successfully, therefore, spraying should be begun as soon as the lice appear, and as most of them are on the underside of the leaves the spray should be directed upward to reach as many as possible.

Of the many ways of making kerosene emulsion, the following is probably the best:

1-2 pound hard soap, shaved fine.
1 gallon soft water.
2 gallons kerosene.

Dissolve the soap in the water, which should be boiling; remove from the fire and pour it into the kerosene while hot. Churn this with a spray pump till it changes to a creamy, then to a soft butter-like mass. Keep this as a stock, using one part in nine of water.

In some cases a strong stream of cold water thrown from a hose upon an infested plant is quite effective, knocking off and killing the lice.—*Mass. Bul.* 18.

A Remedy for the Bitter Rot.

Mr. A. F. Woods, physiologist in the Department of Agriculture in Washington, says that bitter rot, the most destructive disease to the apple grower, can be very effectively controlled by thorough and careful spraying with Bordeaux mixture at the proper time. He says a bulletin will be issued very soon giving full information about when to spray, the conditions, and details of the treatment in each case. Anyone can get this bulletin by addressing a postal card to him requesting the bulletin treating bitter rot.

There was published in last year's annual report a valuable spray calendar giving the remedy and formulas for many diseases and insects. This calendar should be kept for future reference.

Making Good Cider on the Farm.

Good cider can be made on the farm in small quantity, without much apparatus, but as a matter of fact it is seldom so made. The reason for this is lack of attention to details. Only good fruit will make good cider. It is not worth while to waste effort on poor, unripe fruit, or on early fruit with a thin acid juice, weak in sugar. The finished product will never be better than what one starts with. Unmerchantable grades of our very best table fruits should be used for home-made cider. Some of the crabs showing good sugar content, as Maiden Blush, and, occasionally, a good seedling apple make the very best cider, because of the tanning found in those sorts.

The fruit should be clean and free from rot. To use unclean or rotten fruit simply invites bad fermentation. If one puts into the cider all sorts of germs found on soiled, dirty and decayed fruit, he should not expect good results. The fruit should be carefully pulped when it is cool, the juice expressed as quickly as convenient and put at once into clean barrels. Great care should be used in selecting a grinder. Proper machinery will recover four gallons of juice per bushel. German mills, made with stone rollers, will crush the fruit so that four gallons of juice can be recovered by hand. To my mind it is far better to pulp the fruit by hand with wooden mauls, in a wooden trough, than to use some of the modern hand mills. By this method one can extract the juice very effectually. Where only a couple of barrels of cider are wanted for home use, this is not a difficult job, and one secures a juice that will make good cider.

Having secured the juice, a proper barrel is all important. For drinking cider, use only perfectly clean alcohol or whiskey barrels. Never use a barrel that has contained cider or any other liquors than those mentioned above. An old cider barrel cannot be properly cleansed. Barrels should be thoroughly scalded with boiling water and washing soda, then rinsed clean with cold water from a pure source.

Put the barrels, if possible, in a room where the temperature will be fairly constant at 65 to 75 degrees. Lay flat and fill with juice to within eight inches of the bung hole. Cover the bung carefully with clean cotton, so as to exclude the entrance of germs and vermin. This cover readily permits the gases to escape. Never allow it to touch the liquor in the barrel. It is a great mistake to allow the barrels to foam over, as all sorts of germs enter, under such circumstances, and destroy the cider.

As soon as the juice is in the barrel, put into it a cup of good baker's yeast or, what is better, a pure culture of special cider yeast. This sets up alcoholic fermentation at once and largely cuts off the development of harmful organisms. Fermentation will be more rapid by this method. After three days raise the cotton and note the condition of "head" on the cider. It should become thick and turn dark as the first fermentation is completed, but one cannot predict with certainty what will happen in this regard. As soon as the liquor becomes comparatively quiet after this tumultuous fermentation, it will be found fairly bright and limpid. It should then be racked off into a perfectly clean barrel and every care observed not to carry over any of the lees. If this barrel can be kept at a temperature of 55 to 65 degrees, the results will be better. The bung must be carefully guarded as before.

A second fermentation will now set in and as soon as it subsides, the barrel can be tightly bunged and if kept in a cool cellar, the cider will keep for several months. No liquor of such low alcoholic strength as cider will keep if exposed to the air, and air and vinegar germs will find entrance sooner or later. If one is not afraid of using chemicals, they can treat each barrel with about 2 1-2 ounces benzoate of soda and keep the cider for a long time from further change. It is far preferable not to use chemicals, but to watch the cider as fermentation progresses, and when it shows specific gravity of 1.004, rack it free from lees into sound, clean, wine bottles, cork tightly and store in a cool cellar. It is always best to tie the corks down. The bottles should be laid flat. There will still be some slight fermentation, which will render the cider sparkling and agreeably gaseous. Good cider, cleanly made and preserved in bottles is a most wholesome, refreshing drink and especially to be recommended for dyspeptic and gouty persons. I have drank bottled cider twenty years old.—*W. B. Alwood, in Amer. Agri.*

Fertilization of the Peach Orchard.

In connection with the use of fertilizers for the peach orchard the natural fertility of the soil is, of course, the first consideration. In some Northern and Western States and in a portion of the mountain peach orchards from Pennsylvania and Maryland southward the soil naturally carries sufficient plant food to meet the demands of heavy crops of fruit. Of special importance in this regard is the subsoil. If the subsoil is deep and rich and well supplied with phosphoric acid and potash, trees are able to carry immense crops of fruit and still maintain a fairly vigorous condition. However, as a general rule, soils that are suited for peach growing are more or less deficient in the elements of fertility, and it is rare that maximum crops can

be secured without to some degree supplying plant food artificially. In many of the orchards in the more fertile parts of the country but little mineral fertilizer is commonly added. The plowing under of green manures or, perhaps, the occasional application of suitable manure or wood ashes supplied from the farm are about the only fertilizers that are deemed necessary. But often in the more fertile sections the progressive fruit grower has found that while good crops may be secured by good cultivation without the use of fertilizers, still better crops of finer fruit can be secured by supplementing the natural fertility. In all the less fertile sections of the country, especially in the East and South, the fertilizer problem in the peach orchard is one of prime importance. The residual effect of manures and fertilizers used on nurse crops has already been mentioned in connection with cultivation. Nurse crops play an important part, and frequently, when well manured and fertilized, their cultivation for two or three years in the orchard has resulted in ample growth of the trees until a heavy crop of fruit is borne. In fact, the bearing of a heavy crop of small fruit and the subsequent impoverishment of the trees are frequently the first indications the grower receives that his trees are suffering from lack of fertility. It is better, however, not to allow the trees to suffer, but to anticipate the difficulty and fertilize or manure in advance.

Green manures and cover crops should be utilized to the fullest possible extent in the orchard. There are some soils so well supplied with humus that the annual use of green manures is not essential, or, perhaps, in some cases not even desirable, as the amount of humus and nitrogen might be unduly increased and an excessive or belated, immature growth of twigs and buds result. However, in most peach orchards, especially in the sandy and poorer soils, this condition is not to be feared, and annual cover crops should be plowed under. On a moderately rich soil perhaps all or nearly all the nitrogen necessary can be supplied with leguminous cover crops, but even here it is not always safe to depend entirely on the cover crops. Perhaps a dry year may come, with a heavy crop of fruit, and while an unusual draft is made by the trees on the nitrogen of the soil very little is returned to it; therefore the nitrogen should be replaced artificially. Indirect fertilization, therefore, from nurse crops and from cover crops, combined with the natural fertility of the soil, can not be depended upon for maximum crops over most sections of the country. Direct fertilization may be necessary. In the young orchard, where the soil is very fertile, it may not be necessary to fertilize the young trees till they come into bearing.

On poor, sandy land about a third of a pound of fertilizer thrown immediately around the tree is desirable the first year. It should not be in actual contact with the tree, but should be scattered so as to cover a circle about three feet in diameter. The second year the fertilizer can be added after the first furrow has been plowed around the trees, and can be thrown in the furrows on each side of the tree. From a half pound to a pound is desirable at this stage, and should be strewn from a distance of four to six feet along the furrow. The third year at least a pound or more should be used, and it had best be applied in the second or third furrow from the tree in the same manner. Occasionally, on very light land, it is desirable to apply stable manure in the second or third furrow, as above described. The plowing of

the next furrow completely covers the manure or fertilizer, which is thus placed in a good position to be reached by the roots. If the orchard is plowed and fertilized in an east-and-west direction the first year it will probably be desirable to plow north and south the second year, the fertilizer thus being distributed on all sides of the tree.

STABLE MANURE.

The use of stable manure in the peach orchard is a much-debated question. It should never be used on young orchards, except on very poor, light land, and then should always be applied in winter or early in the spring. On bearing orchards stable manure has much effect, stimulating the twig growth and leaf growth more or less at the expense of the fruit. If the soil is already moderately fertile it may distinctly overstimulate the vegetative tendencies of the tree. It has the same effect as other nitrogenous fertilizers in belating the fruit, with a tendency to prevent the high coloring of the product. The fruit is also rendered more liable to the attacks of peach-rot fungus. In extreme cases the effect is distinctly injurious to the general health of the tree, causing gummy exudations from the bark. This is very frequently seen around barnyards and where drainage water from barnyards settles around the trees. Trees are frequently killed outright during a cold winter following an excessive application of stable manure or other nitrogenous fertilizer. On the other hand, trees which have a pale, yellow color, and are suffering from lack of nitrogen on poor, light, droughty soils, are so far below the standard of vegetative growth that they need the stimulus of stable manure to bring them up to the proper level. Here stable manure finds its proper application.

This form of manure is also beneficial in case of several diseases which have an effect similar to poverty of the soil, namely, root aphis and sour soil, and perhaps, also, root rot and some other root diseases. Trees suffering from root aphis and other root troubles are very apt to exhibit symptoms of starvation, and usually respond favorably to the application of stable manure. They can stand very much more manure and profit by it than a normal, healthy tree.

CHEMICAL FERTILIZERS.

As to chemical fertilizers, many old-time peach growers in the Northern States are positive that wood ashes and bone meal are the best fertilizers for the peach orchard. These materials are undoubtedly very excellent for the purpose, and it is very doubtful whether, all things considered, any of the more strictly chemical fertilizers can ever produce as uniformly good results. However, the effect of most experimenting has been to show that potash in the form of muriate or carbonate or sulphate is indistinguishable in efficiency from wood ashes, and the same is true of bone meal. The soluble acid phosphate, or acidulated bone, or bone charcoal, have about the same effect as the bone meal, except that they are more quickly available, on account of their increased solubility. At any rate, there is no doubt but that

the peach responds very favorably to liberal applications of acid phosphate and muriate of potash, as well as to bone meal and ashes. A very good fertilizer for the peach on land fairly rich in nitrogen, or which is well supplied with nitrogen from leguminous cover crops or stable manure, is a mixture containing one part of muriate of potash to three parts of acid phosphate. This should analyze about 12 per cent. actual potash and 10 per cent. phosphoric acid. If a slower action of phosphoric acid is desired bone meal may be substituted for part of the phosphate. This will also increase the nitrogen to some extent in the combination. Bone meal supplies the soil with a very desirable form of nitrogen for the peach tree. If, however, a greater quantity of nitrogen is desired, as on very poor, light, sandy land, bone tankage may be used instead of bone meal or along with the bone meal and nitrate of soda may be also added to the fertilizer. As a general rule, however, it is better to leave out the nitrate of soda and apply it later, when the leaves are pushing out in the spring. The standard mixture for the peach, consisting of potash, phosphoric acid, and insoluble forms of nitrogen, may be applied in the fall, or, in the Southern States, at any time during the winter. At any rate, if applied in the spring this mixture should be put in very early and preferably plowed under, or if the land is plowed very early it may be sown broadcast and harrowed in. Very good results are secured by drilling with a grain drill which has a fertilizer attachment. The following formula may be considered a very excellent fertilizer for poor land, deficient in nitrogen:

10 to 12 per cent. of potash from the muriate.
7 to 8 per cent. of phosphoric acid from acid phosphate.
3 per cent. of nitrogen from bone tankage and nitrate of soda.

An application of 400 to 600 pounds per acre should be considered the minimum where it is only desirable to use a little fertilizer to supplement the natural fertility. On poor, sandy lands, in which the fertilizer is looked upon as the main basis of the fruit production, 1,000 to 1,200 pounds is the proper amount to use. One important consideration should always be borne in mind by the peach grower in planning the fertilization of the orchard, and that is the intelligent use of nitrogen. As already stated, the peach tree is the most vigorous feeder and active grower of any of the fruit trees, and is the most sensitive and easily disturbed by nitrogenous fertilizers. While safer in the long run to withhold nitrogen and allow the trees to slightly suffer for lack of it, yet for best results it is necessary to give the trees just enough of this important ingredient. Barring diseases, nitrogen starvation is indicated by lack of size and color of the foliage, by a slender and weak growth of twigs, and a shortness of joints between the leaves. The annual growth of young trees from one to three years old with good cultivation should be at least three or four feet, and the foliage should be dark green in color. After three years of age, when the orchard comes into bearing, and up to twelve years, the annual growth should be at least eighteen inches, and better, from two to three feet, especially if heading back is practiced. Anything less than this will indicate lack of nitrogen. On the other

hand, too much nitrogen is indicated by a very rank growth of the trees, an unusually dark green color of the foliage, immaturity of the tips of the twigs at the close of the season, by late fruit, with lack of color and poor flavor, and in extreme cases by the gumming of the bodies of the trees without apparent cause. Trees will stand more nitrogen in a dry season than in a wet one. In a rainy year on rich soil the effect of excessive nitrogen seems to be increased by the heavy rainfall, and vice versa in a dry season. Good cultivation has an effect on the fruit and foliage similar to nitrogen fertilization, while lack of cultivation gives somewhat the same symptoms as nitrogen starvation. In both the young orchard and in the bearing orchard the skillful grower will watch his trees when they are pushing out into growth during the month following blooming, and on the bare, sandy knolls and impoverished places will give additional fertilizer—especially additional nitrogenous fertilizer. Nitrate of soda is the most effective fertilizer for quick stimulation of impoverished trees.

Much of the land of the Eastern States best adapted to peach growing, especially sandy upland, is deficient in lime and is considerably improved by the application of from twenty to forty bushels, of eighty pounds each, of stone lime, per acre. The lime has rather a general effect on the soil than an immediate effect on the trees, although it acts as a fertilizer to some extent by freeing potash from insoluble combinations in the soil, and is distinctly beneficial to the peach. It is of benefit in many ways to the peach-orchard soil, improving its mechanical, chemical, and biological condition. It flocculates very light, sandy soils, and renders them more compact and more capable of retaining moisture, while it prevents clayey soils from becoming pasty and cloddy by causing them to crumble on drying. Lime is especially desirable where crimson clover is to be grown as a cover crop. The liming of these light, sandy soils greatly favors the "catch" of clover and the development of the clover plants. Its effect on the cowpea is slightly injurious, but good crops of cowpeas may be grown even on the limed land.

Where newly cleared land is planted to peaches in the sections of country benefited by lime, it is especially important to lime such land. It is better to apply lime where needed as a part of the preparation of the land for peaches. Where this has not been done, lime can be used at any time in the young orchard, preferably after a cover crop of cowpeas has been plowed under in early spring. The beneficial effects of an application of lime are supposed to last from five to ten or even twenty years.

PROF. M. B. WAITE,
U. S. Pathologist

Summer Pruning.

From careful experiments made by the Horticultural Department of the Kansas Experiment Station during the past four years it seems that the pruning of fruit, shade and timber trees during the early summer and late spring is more satisfactory and secures better results than pruning done during the dormant season—winter and early spring.

Wounds made before the middle of July have healed rather more quickly than have those made at a later date, but wounds made as late as August 15 have healed very successfully. The danger of loss of sap is less after the tree is well in leaf than from wounds made during winter and spring. This difference is more noticeable in the maples, elms and mulberry than with other species under observation.

In extensive tests made on an apple orchard some very satisfactory results have been secured with ten-year-old trees which had borne but little and showed but few fruit spurs. Trees pruned in the summer of 1902—the pruning consisting of cutting back new wood and thinning out where a heavy growth shaded the two and three-year-old wood—and a similar but lighter pruning given in the summer of 1903, were full of bloom in 1905 and are carrying a very fair crop of fruit.

Trees pruned in summer have grown fewer "water-sprouts" than those of similar age and grown in a similar soil, pruned in winter or early spring. Water-sprouts removed during summer are less liable to be followed by another crop of the same growth than where the pruning is done in winter.

The operator is less likely to remove a large amount of wood, for he can readily see the danger of sun-scald where too many or too large branches are removed. The thinning out and cutting back of the younger branches should be all that is required when the orchard has had a reasonable amount of care given to its formation, and this light pruning given in early summer seems to be good treatment for unproductive trees.

ALBERT DICKENS,
Horticulturist.

The Sting in the Apple the Work of the Plum Curculio.

Many orchardists are losing a large number of first-class apples by the damage done by this insect, for apples that would otherwise be classed as No. 1 are put in a lower grade when scared by this bettle. In some orchards the loss is quite heavy. It will pay the fruit grower to make an effort to destroy this insect which attacks the apple, peach, plum and cherry.

The "sting" in the apple is caused by the common Plum Curculio, which as an adult beetle makes minute holes through the skin for the purpose of feeding and also for the purpose of depositing eggs.

There is but one brood of these beetles each year, the new adults emerging in the late summer and hibernating over winter in sheltered places.

In the spring the beetles feed on the developing leaves and petals of the flowers, and later on the apple itself.

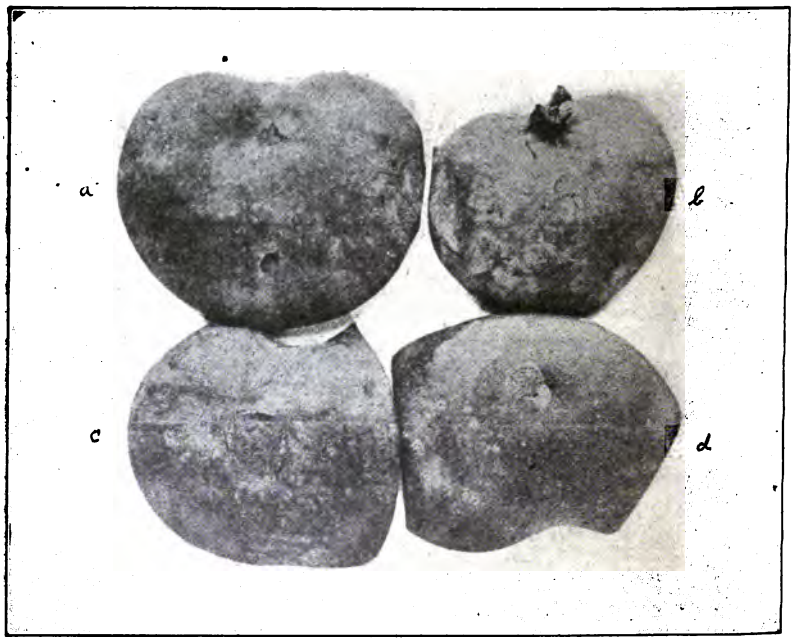
The male beetles feed by puncturing the apple throughout the season, while the female beetles not only do likewise, but also puncture the apples for the purpose of laying eggs.

The number of "stings" which the beetles cause on the apples are far in excess of the production of young, and a very small per cent. only of the eggs deposited ever succeed in producing adult beetles—probably not more than 2 per cent.

The apples containing young larvae must fall by the time the larvae are half grown, otherwise they perish.

The full grown larvae leave the fallen apples and enter the soil an inch or two and there transform to delicate pupae which remain in this stage for two weeks or longer.

The young beetles emerge from the soil in the late summer and feed by puncturing or "stinging" the apple, and later seek winter hibernating quarters.



Portions of apples recovering from the "sting": a, d. scars in depressions caused by the larva entering the pulp a short distance before dying; b.—scar caused by an egg-depositing puncture, the egg never having hatched; c.—scar caused by a feeding puncture. Natural size.

There are three methods of procedure we can follow, each one of which will greatly lessen the insects and therefore the "sting," but all three of which should be used. They are:

Spray the trees once or twice with arsenate of lead before the blossoms open, and then after the blossoms fall, spray every ten days for three or four sprayings. Destroy once every seven days all apples that drop to the ground. Plow the orchard very shallow and harrow it very thoroughly the middle of July, and harrow it again thoroughly the first of August and again the middle of August.

By following all the above three methods the plum curculio can be completely controlled in the apple orchard and damage from the "sting" prevented.—*Mo. Bul.* 64.

Making Vinegar at Home.

F. H. HALL, N. Y. BULLETIN 258.

Why Study Was Needed.—The making of cider vinegar is a familiar operation in almost every farm home. The final product is a necessity on every table, the small apples from which it is usually made are of practically no value for other purposes, the labor and expense of picking them up and pressing them are slight, and from the time the cider is in the barrel Nature does the work. Thus the process appears a simple one, easy to start, and self-operated to its termination in a salable commodity; so that the work-burdened farmer, with several barrels of cider in his cellar, may, in his few moments of leisure, think with pleasure of this farm operation which will bring him profit without further outlay of strength or money.

Simple Yet Complex.—As seen by the farmer, vinegar making is a simple process; to the chemist, though less intricate than many other chemical transformations, it is complex; while to the biologist, the various steps in the change of sugar in the fresh apple juice to the acetic acid of vinegar are manifestations of very complex life activities of many species of organism, divided into two great groups, yeasts and bacteria, each group performing a specific function in the change. There may also come into action, under certain unfavorable conditions, other bacteria which hinder the useful transformations, or which destroy the products desired and thus lower the quality of the vinegar. This interplay of living organisms, sometimes for good, sometimes for ill, has not been studied in all its details, and has been considered, in this investigation, only as results were produced, the chemical transformations alone being considered.

Chemistry of Vinegar Making.—In a general way these transformations are two: Sugar, the ordinary cane sugar and other forms known as invert sugars (dextrose and levulose), in the sweet cider, is first changed into alcohol through the fermentative action of one group of organisms; then the alcohol, by the action of a second group of organisms is changed to acetic acid.

Chemically considered, each molecule of sugar consists of six atoms of carbon, twelve atoms of hydrogen and six atoms of oxygen. When this molecule of sugar is acted upon by the proper ferments, it passes through a series of chemical changes which may be said to result, finally, in splitting it up into two molecules of alcohol, each containing two atoms of carbon, six of hydrogen and one of oxygen, and two molecules of carbon dioxide gas, each containing one atom of carbon and two of oxygen.

Theoretically, we should be able to get from 100 parts of sugar by weight, about 51 parts of alcohol and 49 parts of carbon dioxide; but because of evaporation and certain minor chemical changes we can get in practice only about 45 to 47 parts of alcohol or less.

After the alcohol is formed, the organisms which act upon it begin the transformation to acetic acid. In this process oxygen is taken from the air.

Theoretically, again, we should obtain from 100 parts of alcohol about 130 parts of acetic acid, but we usually get less than 120 parts. So, starting with

100 parts of sugar in the apple juice, we may get under favorable conditions from 50 to 55 parts of acetic acid; therefore to have vinegar with 4.5 per cent. of acetic acid we must have juice containing not less than 8.5 per cent. of sugar.

Sugar in Apples.—This percentage, however, is found in practically all ripe, sound apples, although in a record of about 100 analyses of eighty varieties of American-grown apples, made at this Station, in Washington, D. C., in Pennsylvania and in Virginia, five samples, of as many different varieties, were too low in sugar to produce vinegar of the required acidity. The sugar in apples reaches its maximum in ripe fruit, being low both in those that are green and those that are overripe. It averaged, in the apples used in the tests at this Station, 13 1-3 per cent., and varied less than 2 per cent. either above or below the average. A somewhat surprising fact to those not familiar with the chemistry of the subject, is that "sweet" apples do not owe their sweetness to their large percentage of sugar, but to the small amount of malic acid they contain. For example, the sample of Red Astrachan juice contained 10.16 per cent. of sugar and 1.15 per cent. of malic acid; while Tolman Sweet and Sweet Bough contain about the same amount of sugar, but only 0.10 to 0.20 per cent. of malic acid.

Alcoholic Fermentation.—Starting, then, with juice containing sufficient sugar, what are the conditions which will best promote the changes to alcohol and to vinegar and prevent loss? The sugar must first be acted upon by the enzyms, or ferments, which are produced by yeast plants. The yeast germs are usually present everywhere, so that they pass from the surface of the apples into the juice as it is pressed out, or fall into the cider from the air. It has sometimes been held unwise to wash apples before pressing them, for fear of carrying away the necessary yeast germs; but the apples used in all the station tests were washed without apparent interference with alcoholic fermentation. If apples have become dirty it is certainly best to wash them, as otherwise there is danger of introducing bacteria that interfere with proper fermentation. In ordinary cellar temperature, most of the sugar is changed into alcohol in five or six months, the change being slow during the first month, but quite rapid during the second, third, and fourth months. The process may be greatly hastened by storing in rooms warmer than cellars usually are during the fall and winter months. By placing bottles of vinegar in rooms of different temperature, running from 55 degrees to 85 degrees F. it was found that at 55 degrees only 2 1-4 per cent. of alcohol was formed in three months; at 60 degrees and 65 degrees F., more than 4 1-2 per cent.; and at 70 degrees and 85 degrees F. about 6 1-2 per cent. was formed in the same time. At higher temperatures than this evaporation of the alcohol would be liable to cause loss.

The addition of yeast also hastens alcohol formation, so that at a temperature of 55 degrees F. cider with yeast added gave 6 1-4 per cent. of alcohol. and at 70 degrees F., with yeast, 7 1-4 per cent., both in one month. The use of any form of commercial yeast, if sufficiently fresh, will probably be found to give good results.

Acetic Fermentation.—After the yeast fermentation has been completed the acetic-acid forming bacteria begin to attack the alcohol and produce acetic acid. This process is ordinarily very slow for about three months

after the sugar has all been changed to alcohol, that is during the eighth, ninth and tenth months of cellar storage; but advances rapidly from the tenth to the fourteenth month, and is practically completed in two years. This process also moves more rapidly, when once well started, at higher temperatures; but differences of temperature appear to have little effect during the three months after the sugar has disappeared. Beginning with the tenth month of storage, however, and up to the end of two and a half years, nearly twice as great a percentage of acetic acid was produced where the temperature varied from 50 degrees to 90 degrees F. as where it was from 45 degrees to 65 degrees F. The percentage of acid formed at lower temperatures never became as great as at higher temperatures, though part of the apparent increase in the warm room was due to evaporation of the water. The best results were secured at temperatures of 65 degrees to 70 degrees F.

It is the ordinary practice to add vinegar, especially vinegar containing "mother," to the barrels in which vinegar is making; and the investigation proved the practice a most excellent one, as the acetic fermentation was more rapid and more complete in every case where this form of inoculation or "seeding" was used. This addition of "mother" is comparable to the addition of a "starter" in souring milk, for the "mother" is produced by the growth of the acetic bacteria in the presence of air and contains large numbers of these bacteria.

It appears to be of advantage in some cases to draw off the clear portion of the cider after alcoholic fermentation has been completed, leaving the dregs; and to continue the process in new clean barrels or to wash out the settlings and return the clear liquid to the barrels. This proved of considerable advantage in the case of vinegars stored at low temperatures, but of less utility when the vinegar was stored at higher temperatures where the acetic fermentation proceeded rapidly. Possibly with cider made from uncleaned apples and carelessly strained juice the results along this line would be more striking; for the liability to contamination with undesirable germs would be greater in such cases.

Loss of Acetic Acid.—In both alcoholic fermentation and acetic frementation, the air should have free access, especially in the latter; for, as can be seen by the equation given to explain the process, oxygen must be added to alcohol to make the acetic acid, and this must come largely from the air. On this account the barrels should not be filled more than two-thirds or three-fourths full with the apple juice, or with the "hard" cider. But when the acetic fermentation has ceased to be active and the amount of acetic acid is safely above 4 1-2 per cent. the vinegar should be drawn from the barrels and strained, the barrels cleansed, the vinegar returned filling the barrels full, and the bung driven in tight.

Unless this is done, destructive fermentation may begin and the acetic acid decreases instead of increasing. In several experiments where the vinegar was held in loosely stoppered casks or bottles, it lost all or nearly all its acid, and in some cases actually became alkaline in reaction. This destructive fermentation may be due to new species of bacteria introduced, or even in some cases to the same acetic-acid- forming species which, when the alcohol is exhausted, attack the acetic acid itself.

As showing how complex may be the processes passing in vinegar, the case may be cited of four one-quart bottles of the same juice stored under the same general conditions. At the end of five years bottles a and b contained 5.74 and 5.44 per cent., respectively, of acetic acid, bottle c 2.10 per cent. and bottle d gave an alkaline reaction. Bottles a and c contained nearly three times and bottle b 2 1-2 times as much solids as bottle d.

Malic Acid.—The acid of fresh apple juice is not the acid of vinegar, but a fixed acid called malic acid. This has certain chemical characteristics which make it quite easily recognizable; and so its presence in vinegar has been considered an index to determine whether the vinegar were or were not truly vinegar from apples. But these investigations have proven that this acid disappears quite rapidly from vinegar, so that in twenty-four months it had shrunk from an average of 0.55 per cent. to 0.02 per cent.; while in some older vinegars it had disappeared entirely. The relation of malic acid to cider vinegar is being further studied.

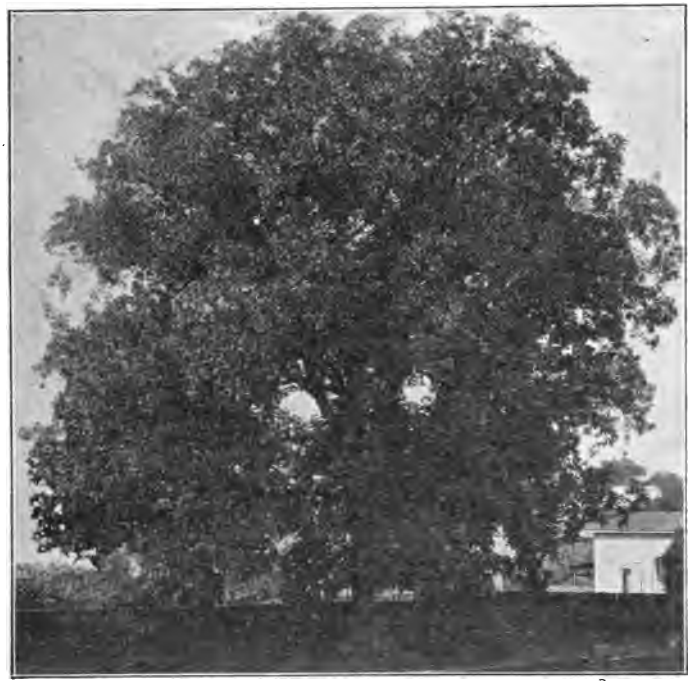
To Make Good Vinegar.—Briefly summarized, the method to be employed for the manufacture of good vinegar at home, without the use of generators, is this: Use sound, ripe apples, picked or picked up before they have become dirty, if possible, otherwise washed. Observe the ordinary precautions to secure cleanliness in grinding and pressing, and discard all juice from second pressings. If possible, let the juice stand in some large receptacle for a few days to settle; then draw off the clear portion into well-cleaned barrels which have been treated with steam or boiling water, filling them only two-thirds or three-fourths full. Leave the bung out, but put in a loose plug of cotton to decrease evaporation and to prevent the entrance of dirt. If these barrels are stored in ordinary cellars, where the temperature does not go below 50 degrees or 45 degrees F., the alcoholic fermentation will be complete in about six months; but by having the storage room at a temperature of 65 or 70 degrees the time can be considerably shortened, and the addition of Fleischmann's compressed yeast or its equivalent at the rate of one cake to five gallons of juice may reduce the time to three months or less. Use a little water to thoroughly disintegrate the yeast cake before adding it to the juice. The temperature should not go above 70 degrees for any length of time, to avoid loss of the alcohol by evaporation.

After the sugar has all disappeared from the juice, that is, when the cider has entirely ceased "working" as revealed by the absence of gas bubbles, draw off the clear portion of the cider, rinse out the barrel, replace the liquid and add two to four quarts of good vinegar containing some "mother," and place at a temperature of 65 to 75 degrees F. The acetic fermentation may be complete in three months or may take eighteen months according to the conditions under which it is carried on; or if stored in cool cellars may take two years or more. If the alcoholic fermentation be carried on in the cool cellar and the barrel be then taken to a warmer place, as outdoors during the summer, the time of vinegar formation may be reduced from that given above to fifteen or eighteen months. Where the alcoholic fermentation is hastened by warm temperature storage and the use of yeast and the acetic fermentation favored by warmth and are good vinegar "start," it is possible to produce good merchantable vinegar in casks in six to twelve months.

When the acetic fermentation has gone far enough to produce 4.5 to 5 per cent. of acetic acid, the barrels should be made as full as possible and tightly corked in order to prevent destructive changes and consequent deterioration of the vinegar.

Profitableness of Pecan Culture.

The modern method of planting and cultivating the pecan tree has opened up a profitable industry, and the introduction of improved varieties, which come into bearing in from six to ten years, according to the varieties selected, has shortened the period of waiting, which has heretofore been the only barrier to pecan culture.



Pecan tree now growing in Dinwiddie County, which frequently bears six or eight bushels of nuts.—American Nut Journal.

While commercial pecan planting is still in its infancy, it has been engaged in long enough to demonstrate its profitableness. Many capitalists are investing in large pecan groves and hundreds of acres are being set every year to these trees. The pecan is one of the hardiest of trees, belonging to the hickory species. It grows to an immense size and is long-lived. It is found growing wild in all the Southern States, flourishes as far North as Indiana, has practically no enemies, and grows on almost any soil. As a shade tree it

has no superior. Every house in city, village or country should be surrounded by several of these beautiful trees, for, besides being ornamental, the bountiful crop of nuts furnished each fall makes it one of the most desirable of trees. With proper care, it is a rapid grower, and will come into bearing in from five to ten years—depending on whether budded or seedling trees are planted—and will continue to increase in yield for thirty or forty years, when a yield of from one to five barrels will be permanent for generations. There are trees ten years old that measure five feet in circumference, with height and spread of branches proportionate. Many trees, from twelve to eighteen years old, produce annual crops worth $150. It can readily be seen how valuable even a small grove of such trees would be.

The United States is the only continent on which pecans are grown; therefore, the world is its market. Unlike other fruit, there is no necessity for careful picking, handling and storing. The nuts are gathered easily and can be held for a considerable time, to be sold when desired. The demand for the improved nuts is such that they never reach the trade, but are bought by private individuals often a year in advance of the harvest.

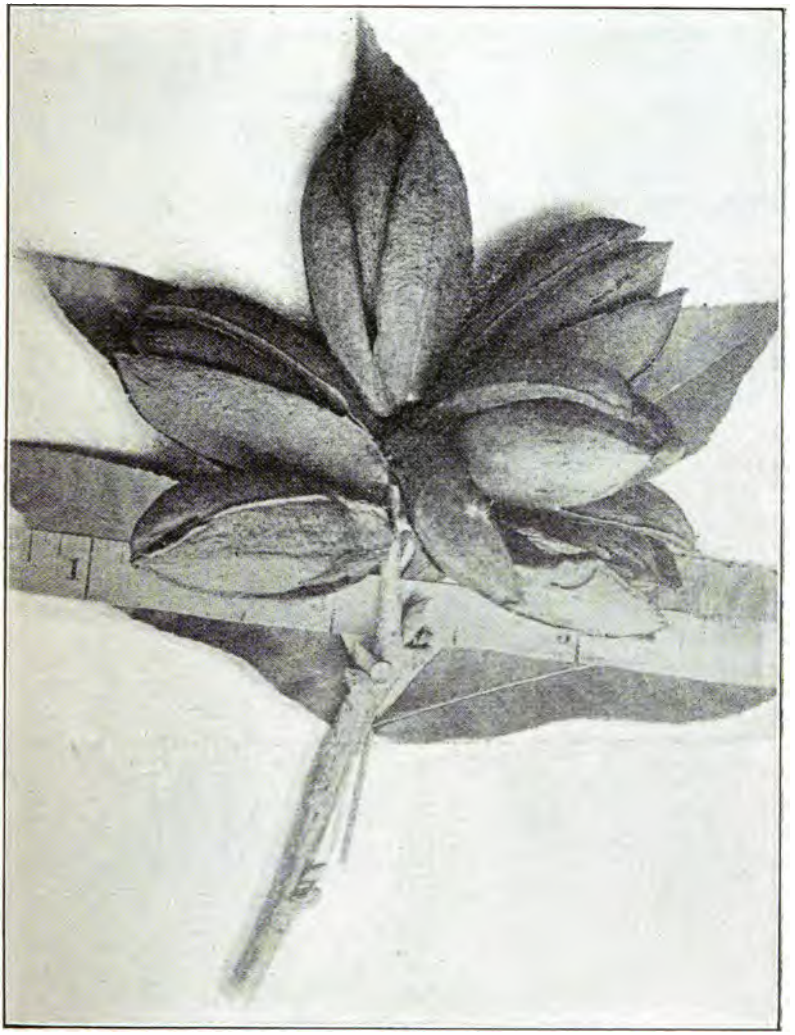
That pecan culture in Southside Virginia could be made highly profitable, there is no doubt. Many seedling trees in the counties around Petersburg yield large crops, although no attention is given them. A few acres could be planted to pecan trees at small cost, with the assurance that the investment would be a safe and profitable one. By cultivating the land in other crops during the waiting period, the business could be made self-sustaining from the start, while the enhanced value of every acre of land planted would each year amount to as much as the land cost. One can afford to wait six or eight years for profits when the cost of the investment is sure to be returned, together with large annual profits, for a period measured by generations.

Plant Walnuts on the Farm.

At a meeting of the State Horticultural Society of Pennsylvania at Harrisburg, John G. Rush read an interesting paper on the Persian walnut (Juglaus regia), known also by the various names of German walnut, European walnut, Dutch nut, English walnut, Mareira nut, etc. While this royal nut most likely originated in Persia, the many names it has received show how widely it has been grown, and this fact also indicates its adaptability to various conditions.

At present almost $500,000 worth of Persian nuts are imported into this country annually. California produces nearly all the American grown Persians in the home market, yet hardy Persian walnut trees may be found in nearly all parts of the United States where the black walnut (Juglaus nigra) thrives.

Mr. Rush, with much care, investigated the Persian nut in his home county (Lancaster, Penn.), and found many old and hardy trees, only about 4 per cent. of which were productive. In his experience seedlings were very unreliable, not only as to productiveness, but fully as much so in regard to hardiness. Seedlings grown from nuts produced at home generally showed evidence



A Pecan Twig Full of Nuts, From Southside. Va.

of being hybrids, having in some way become tainted with the native black walnut. This could be detected even in very young seedlings by the number of leaflets, the presence of serrations in the leaflets and the pressed or bruised leaves giving the characteristic pungent odor of the black walnut, instead of the mild, pleasant odor of the true Persian.

As with the apple and other fruits, the only road to success is through propagating by grafting or budding the best varieties. As stocks the whole walnut family may be used.

Mr. Rush has produced in Lancaster county, Penn., fully three bushels of fine Persian nuts from one small tree, and thinks the Eastern or Middle States should and could produce all the nuts needed for our Eastern markets. He considers the production of these nuts especially fascinating, as the properly selected varieties are remarkably hardy, free from insect pests and the various diseases usually preying upon fruit and fruit trees.

There are a number of large English or Persian walnut trees bearing in Virginia. Some trees in the Valley of Virginia are yielding a barrel of walnuts to the tree. Every farmer should plant some of the different nut trees that will grow in this climate, and there are many. There are also some improved black walnuts that are profitable to plant in the vacant and waste places on the farm that will make fine logs for market in twenty-five years.

Miscellaneous.

Poultry Raising for Profit.

BY J. D. MASON, GLADYS, VA.

[Mr. Mason has now more than 5,000 chickens on his farm, and is an expert poultryman.—*Com.*]

In the year 1903, having a large tract of land and raising a considerable quantity of grain, it was a problem as to how we could dispose of these products so as to get the greatest profits from the land. The poultry business seemed to us a solution of the problem.

Unfortunately, at the present time in the South, the poultry business is considered simply a pastime for the women of the household, so we were forced to go North for practical business ideas.

Considerable time was spent investigating the business and in looking over the large poultry plants of New York and New Jersey. The result of this investigation was we decided to select the single comb white Leghorn as our breed.

Being told that the business is not without difficulties, which subsequent experience has confirmed, we decided to experiment somewhat before going into the business in a large way. In the spring of 1903 two incubators of three hundred and sixty egg capacity, of one of the best makes, were purchased and were placed on the dirt floor of an old unused summer kitchen. Two crates of single-comb white Leghorn eggs were shipped from two of the most reliable poultry plants of the North, one crate costing at the rate of six cents apiece, the other four cents apiece. These were started for hatching on March the fifteenth. We have never in all our experience gotten better hatches than we got out of these shipped eggs. At the time they were shipped, owing to a strike of the express employees on our shipping line, we had to bring these eggs over a very rough road from a distant depot on another railroad line. As this very rough usage did not affect the hatches, we are confirmed in our belief that it is a mistaken idea that shipping eggs injure them for hatching, provided the eggs come from good healthy stock, which insures strong germs.

Allowing for breakage and unfertile eggs, out of two hundred and eighty-two fertile eggs, two hundred and seven chickens were taken from incubator No. 1. No. 2 gave us two hundred and eighteen out of two hundred and eighty-seven fertile eggs.

These chickens were reared in a home-made brooder, from which the air was carefully excluded, and heat was furnished by means of brooder lamps. This every-day experience brought us face to face with hatching and rearing chickens by artificial means.

NATURAL AND ARTIFICIAL INCUBATION OF CHICKENS.

If going into the business in a large way, incubators and brooders are a necessity. While hatching by the natural method undoubtedly gives best results, still it is impossible to have broilers in large numbers when prices are highest, if depending on the mood of broody hens.

In the matter of incubators the best to be had are the cheapest in the end, and we strongly condemn experimenting with home-made affairs. They are discouraging to beginners.

Very clear and practical instructions come with all incubators of the best make, and if carefully followed even inexperienced persons can run them successively.

Nearly all poultry writers favor a damp cellar as the best place for hatching chickens in an incubator, because of the moisture. We doubt the advisability of this. It is absolutely necessary that the embryos have pure air, and everybody knows that the air is never pure where there is constant dampness. If a dug-out cellar is used the floor should be cemented to keep it dry and the air pure. If the cellar is even with the ground it is not necessary to cement it, for such cellars are seldom damp. Sprinkle the floor well when the eggs begin to pip and keep this up all during the time the eggs are hatching, and this will give all the moisture needed. Get all the pure air possible without a draft, and the best way to secure this condition is to have the windows open but sufficiently screened to prevent draft.

After placing the incubator so that it is perfectly level, open door and ventilators, place a lighted candle inside, close door and carefully test the amount of air inside by gradually closing up ventilators just sufficiently to keep the candle burning. If it begins to flicker, there is not enough air and the ventilators should be opened just a little more or just enough to keep the candle burning. Test this for about ten minutes before starting off hatch and remove before putting eggs in Few manufacturers of incubators give this test in their instructions but it is most important. Oxygen is necessary for the embryo after it begins to breathe. The lack of it causes poor hatches and weak chickens. Some poultry men claim that it is the chief cause of poor hatches and weak chickens.

For profitable broilers, we start our hatches in February. We get our highest percentage of chickens from eggs hatched in April. In our hot-water heated brooder we raise them equally as well when hatched out early, although we do not get as good results in hatching. After the end of May in this climate, unless the weather is unusually cool, eggs do not hatch so well nor are the chicks as thrifty. It is difficult to regulate the heat, either in incubator or brooder, which causes the trouble. Experiments with hatching our eggs under mongrel hens, set June twenty-second, gave us nine healthy chicks, all of which lived, out of nine eggs. On July the third, another setting gave us eleven chicks out of fourteen eggs, the eggs in both cases having been carefully selected. By this test it would seem that the weather has little effect on eggs hatched under hens.

All eggs used for hatching should be carefully selected, and all misshapen eggs rejected. Pullet eggs hatch well, but produce weak chicks that

seldom live, so it is a waste of time and eggs to set them; neither do very old hens produce vigorous chicks. *Yearling and two-year-old hens* furnish the best hatching eggs.

After seeing that the incubator is at the required temperature of one hundred and two and a half degrees, it will only require the attention of turning the eggs twice a day, morning and night, after the third day, the testing out of the fertile eggs, and the filling and trimming of lamps daily. In very sudden changes of weather, the temperature may require lowering or raising, as may be required, keeping the temperature at one hundred and two and a half degrees as nearly as possible, by raising or lowering the lamps.

The best method of turning eggs is to take out the first two rows in the center, roll the remainder down to the center, and then replace at the end the two rows taken out.

Excellent egg-testers, with instructions as to use, are furnished with most incubators. These testers can be placed on an ordinary lamp, and the eggs are best tested at night when the room is dark. On the sixth day of incubation we consider them at their best for testing. A good strong germ has the appearance of a spider in the egg. A blood circle adhering to the shell denotes a dead germ, a perfectly clear, as well as a cloudy egg is unfertile and should be removed from the incubator. These rejected eggs can be retested and the clear ones taken out for use. In some markets they can be sold at a lower market rate per dozen to bakers, for they are perfectly good for cooking purposes, or they may be used at home, or hard-boiled, chopped up and given to young growing stock.

From the tenth to the eighteenth day cool eggs by leaving the door of the incubator open after the morning turning of eggs, letting the temperature drop to ninety degrees.

On the morning of the nineteenth day the eggs are turned for the last time, provided they are not already pipping. They should all be carefully spread out in the trays in order that the chicks may fall into the nursery of the machine, both from the back and the front, and so prevent unnecessary tramping over the eggs that are hatching. At this time the ventilators are closed until the hatch is two-thirds over.

Hatching eggs under hens is a much simpler matter. In some experiments we made in hatching out white Leghorn eggs under mongrel hens we got the best results from hens fed on corn while sitting, corn being the greatest heat producing food.

Hens should not have eggs put under them until they have kept to the nest for a day or so. If they do not leave the nest for the roost at night, it is safe to put eggs under them. Our hens, which were set in the hen houses, did not do so well as those set where they were undisturbed by the laying hens. If it is necessary to move the hen, they will generally accept the new nest provided the change is made at night. Dark nests give the best results, and they should be well filled with straw or dried grass.

From twelve to fifteen eggs are put under a hen, depending on the size of the hen. In cold weather it is best to put the fewer number of eggs, while late in the spring as many as seventeen can be put under them. It is just as necessary to select the eggs and use only well shaped eggs for setting un-

OUTSIDE VIEW OF BROODER HOUSE.

der hens as for the artificial method of hatching. In warm weather when the chicks are liable to dry in the shell it is a great help to thoroughly sprinkle the eggs. There need be no fear of chilling, for the heat of the hen will quickly bring them back to the proper temperature. If two or more hens are set at the same time, it is advisable to give one of the hens both lots of chickens to mother and reset the other.

If the hens are lousy a second setting is not to be advised.

Before starting our hatches, we thoroughly fumigate our houses by burning sulphur candles in them, and as an extra precaution we sprinkle both hen and nest with lice powder. Lice will lower a hen's vitality, reducing her heat and causing in this way poor hatches.

Hens are inactive while sitting, and therefore require less food than otherwise. It is not necessary to feed them on the nest. Have food and water accessible, but let their appetite be the judge of when and how much to eat. As far as possible let them be undisturbed while sitting.

THE REARING OF YOUNG CHICKENS.

We allow our chicks to remain in the incubators forty-eight hours. They will not require food nor water during this time.

When first put in the brooder a little "pearl grit" is given them and they are also watered, care being taken to take the chill off the water. Very cold water is fatal to young chickens, causing diarrhœa, and it should always be tempered before it is given them.

The floor of the brooder should be covered with dry sand to the depth of about an inch, over which is scattered cut clover or chaff to make a scratching litter about an inch deep.

Two hours after they are put in the brooder they have their first meal, consisting of a prepared dry grain ration known as "chick feed." This can be purchased from any dealer in poultry supplies, or it can be made at home according to the following formula:

Six pounds cracked wheat.
Two pounds cracked corn (fine).
One pound rolled oats, or pin-head oatmeal.
One pound millet seed.
Half pound broken rice.
Two pounds fine granulated beef scrap.
Half pound granulated bone.
Six pounds pearl grit.

This should be fed every two hours during the first three days, giving three handfuls scattered in the litter, to every hundred chicks. From the third to the tenth day the same amount should be fed from 6 A. M. to 6 P. M. every three hours. Fresh water and ground charcoal should be kept before them at all times. From ten days to four weeks the feed should be increased to four handfuls given four times a day. Begin at this time to keep scrap meat before them. After four weeks increase again, giving five handfuls three times daily. From six weeks up to eight weeks add about three handfuls of cracked corn and whole wheat to the ration. When feeding, if these quantities do not seem sufficient, or if at the next meal it is

found that the last meal was not entirely consumed, increase or decrease from these directions. The object is to give enough to make them thrive, yet at the same time regulating the amount so they will keep hungry enough to scratch. It is necessary that they get exercise if they are to make progress.

At six weeks we select the largest cockerels that we do not wish to keep for stock and put them in separate pens, where they are fed entirely on cracked corn until the seventh week. The eighth week we feed them corn and a cornmeal mash made very dry. At the end of eight weeks they are shipped for broilers. Later in the spring they are crate fattened, that is, they are kept in crates for two weeks before shipping, getting no exercise and are fed high on cracked corn and cornmeal mash. They take on fat very rapidly under this treatment and quickly reach broiler size, besides they have a flavor impossible to get in any other way.

We ship in ordinary coops on foot to nearby markets, to a private trade, hotels, restaurants and hospitals taking all we can ship.

At eight weeks old, all pullets and cockerels saved for stock should be put into the colony yards on free range, where they stay until they are put in laying pens. They should be accustomed to this change by moving them up into the coolest part of the brooder before turning them out. If they are raised in outdoor brooders, gradually decrease the heat at night, cutting it off entirely three or four nights before they are given free range.

Right here we wish to say something about square corners in colony houses. We learned from experience that when first put in colony houses, the chickens being unaccustomed to roosts, will crowd in the corners and smother. We rounded the corners in our houses by tacking wire netting across them. Sudden storms are another source of danger. Doors of the houses may blow closed, the chickens will crowd together under anything at hand and smother. We lost some fine birds in this way. They should all be housed before a storm.

After being put in the colony yards we feed a mash in the morning before they are scattered over the yards. The mash is made as follows:

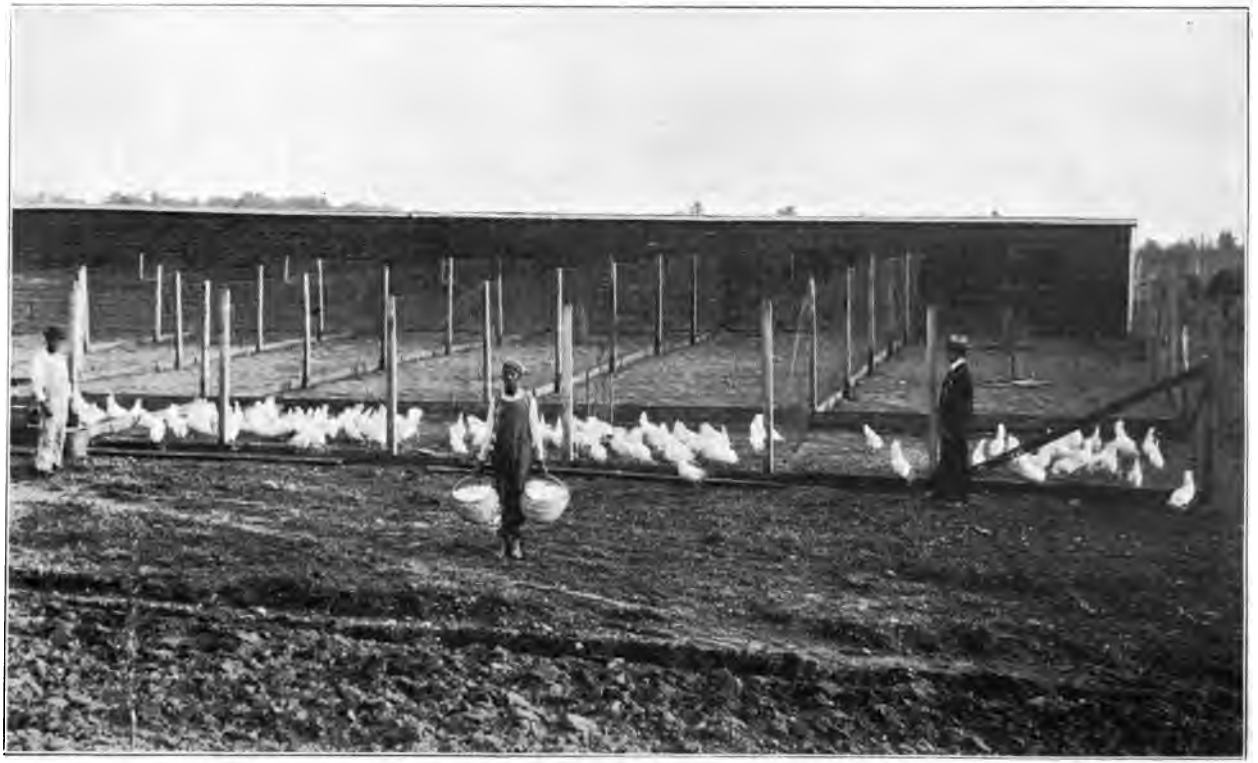
One part beef scrap.
Two parts cornmeal.
Three parts ground oats.
One part wheat middling.
Two parts bran.
A pinch of salt.

Mix with warm water, taking care not to get it too wet. It should just be wet enough to hold together.

We feed our early hatched pullets lightly after they are put in the colony yards. If fed heavily they will molt early and will not lay when eggs are selling at their highest. In September or sooner we move all early hatched chickens into the laying houses, so they may become accustomed to their new quarters and be ready for egg production when needed.

BROODERS AND BROODER MANAGEMENT.

Bulletin No. 6 gives some idea of our hot-water heated brooder used for raising chickens artificially. Such brooders solve the problem of rearing



FEEDING AND EGG GATHERING AT MR. MASON'S POULTRY FARM.

chickens without the mother hen. We have raised as high as 90 per cent. with some lots, while other lots, late hatches chiefly, have fallen as low as 70 per cent. Eighty per cent. is considered the average number raised with good management.

During the first part of the spring, while the weather is cold, we have a watchman sleep in the brooder. He uses an alarm clock to awaken him and he gets up and replenishes the fire in the furnace in order that the temperature may not drop and the chickens get chilled. If they do, hundreds will die as a consequence. The stoppage of the vent, which plays such havoc with young chickens reared artificially, is caused by bad management of the brooder, either too much or too little heat. Ninety degrees throughout the brooder, while ninety-five under the hovels, is the proper temperature to keep them.

They need fresh air, so ventilators should be placed so as to prevent a draft, yet at the same time admit plenty of air. On warm days let the chickens out in the runs; while out take the opportunity to thoroughly clean out the brooder. This should be done at least once a week.

In August of each year these runs are spaded up and sown in rye, which furnishes the green food in the spring, which is so necessary for their health.

With chickens raised with the mother hen, the question of heat does not have to be considered, but when no hot-water heated brooder is to be had for artificial rearing, the outside brooders, heated with coal-oil lamps, give very good results. In the month of September we experimented with them and succeeded in raising seventy-two out of one hundred chicks, though later during the fall results with their use were not good. Thev run at a temperature of ninety degrees, and our experience was that in very cold weather it was difficult to keep them at this temperature; therefore later than September or earlier than April they will not give good results. However, if the weather is mild, they are very satisfactory.

They are simple to run, only requiring that the lamps be kept filled and clean. Like incubators, they require the best grade of oil.

MANAGEMENT OF LAYING AND BREEDING HENS.

Forty hens are put in each 16x16 foot pen for market eggs. These hens have access to outdoor runs. They are usually our spring hatched pullets, and on them we depend for our greatest egg receipts.

Their quarters are kept in the best sanitary condition. They are plentifully supplied with grit, oyster shell, bone and charcoal, fresh water and deep litter to scratch in. We use cut straw for litter, or leaves; however, if it can be had, cut clover makes the very best litter. The litter must be good and deep, for they must scratch and take exercise if they are to fill the egg baskets.

Very early every morning the hens are turned out and allowed to scratch around to get up an appetite before they are fed. The first meal is fed about eight o'clock in winter, and consists of a dry grain feed, one part wheat and one part oats. In winter they are watered after feeding, in summer they are

watered first. At noon we feed a mash, mixed with steamed clover and made in the following manner:

Two parts crushed oats.
Two parts bran.
One part cornmeal.
Three-fourths part wheat middling.
Three-fourts part. scrap meat.
A pinch of salt.

Mix these thoroughly and add the steamed clover, making the mash just moist enough to hold together. Twice a week we add a few handfuls of pulverized charcoal to this mash. Experiments gave us the best results from the mash when fed at noon.

The steamed clover is fed in the winter to take the place of green food. In addition to this we feed throughout the winter whole cabbage, turnips and sugar beets chopped fine. The night meal again consists of a dry grain feed scattered in litter, one part crushed corn and one part oats. In severely cold weather we feed a heavy meal at night consisting entirely of whole corn. Corn is the heat producing food that furnishes warmth in cold weather.

This programme is somewhat varied in summer, for the hens are turned out in large runs back of the houses, where they get all the green food they need, and the mash is simply mixed with water instead of with steamed clover. They are also fed the grain feed broadcast in the runs and do not require any litter to scratch in during this season of the year. In the summer we feed very sparingly of corn, giving the same winter feed fed in the morning throughout the year, while at night they have plain oats.

The quantity given will depend on the appetite and condition of the fowls. The general rule is to feed all they can clean up well in about ten minutes. If they are too fat, they will require less food; if poor, more food, consisting of a more liberal supply of corn. If there are evidences of diarrhœa, cut out all mash, giving a dry grain feed until cured. We find the mash a great egg producer, but it is fattening, and care must be taken not to feed it too liberally.

A good rule to remember is that the carbonaceous grains are the heat and fat producing foods, while the grains rich in nitrogen are the egg producing foods, and a careful combination of both will give greatest results. Generally speaking, wheat is considered the winter egg forcing food. Breeding hens are fed in exactly the same manner. They are, however, put in different quarters, twenty hens instead of forty being put in 8x16 foot pens.

For breeding Leghorns one cock to twenty hens will be found satisfactory. With the heavier breeds, such as Wyandottes and Plymouth Rocks, two cocks are required for mating with twenty hens.

We have put in operation in all of our houses trap nests like illustration No. 7. Our hens are all banded, each hen having a number. Every half hour or so we release the hens that have laid, crediting them by their number with the egg laid. In this way we are able to eliminate all drones, keeping only egg producing fowls. We can in this way continue to improve the laying qualities of our birds by hatching from the best egg producers.

LAYING AND BREEDING HOUSES IN WINTER RUNS.

We sell all hens after the second year. They are at their best for laying the first year and are necessary to furnish strong hatching eggs the second year, but they lay fewer eggs each year, and cannot be kept at a profit after the second year.

Pullets gave us during the past year an average of one hundred and sixty eggs to each hen. Yearling hens seldom lay more than one hundred and thirty eggs a year. Some individual hens will go greatly over this and some very much under it. With good feeding pullets certainly should average one hundred and forty-four eggs each.

7. View of Trap Nest.

Two hundred-egg hens exist in individual hens, but we know of no strain producing two hundred a year per hen, and even individual hens with this record have to have very good management to come up to this mark.

The cost of feeding a hen and the profit derived from her will depend on the market for eggs, and the cost of food stuffs in the locality. The large poultryman who can handle a regular trade throughout the year will be able to sell his eggs and poultry ahead of the market prices, while at the same time he saves by buying food stuffs in large quantities. The sale of hatching eggs and thoroughbred stock will also considerably add to his profits. He will be able to make much more per hen than the smaller poultryman.

Ninety cents per hen is generally given as the cost of feeding a hen. We consider this a very liberal figure for feeding in the South, where feeds are cheaper than they are North. If the poultryman raises his own grain, he will be able to feed at the lowest possible cost.

Little attentions given to the details of the business will enable a poultryman to get the highest market prices. For instance, we ship only spotlessly white, clean eggs, with each egg bearing our name and guarantee of freshness. This educates the consumer to first-class eggs; they call for them and the grocer has to pay us for our trouble.

We find the poultry business profitable, and for a farmer with young sons for help it is an ideal business. The work is constant, but not heavy, and one man can attend to a large number of chickens.

BREEDS OF POULTRY.

There are eighty-seven standard varieties of chickens in America. It is generally conceded that the Mediterranean varieties excel all others as layers, while the American varieties are popular as general purpose fowls.

Portable Colony House.

The following varieties are almost exclusively raised for commercial purposes: Single and rose-comb brown and white Leghorns, barred, buff and white Plymouth Rocks, white and silver penciled Wyandottes, and Rhode Island Reds.

We like the single comb white Leghorn because they are the best general layers. They are showy in appearance, mature quickly, making small but delicious broilers more quickly than any other variety. They lay a large white egg suited for fancy trade, and they are non-sitters.

White Wyandottes are a very popular breed. We raise a few pens of them and find them excellent winter layers, but not such good general layers

as Leghorns. They make large heavy broilers, but develop more slowly than Leghorns, therefore cost more to raise and are not so profitable for broilers.

Plymouth Rocks are also good winter layers and are a most popular breed. They are being raised now by many poultrymen for capons instead of Brahmas, which have heretofore been used exclusively for caponizing. Plymouth Rocks are better layers than Brahmas and will grow nearly as large with proper care. We are experimenting this season with raising some Plymouth Rocks for capons. Capons should be better known in the South. We believe they can be made to largely take the place of turkeys in the Southern markets and they are more profitable to raise.

Operating in Caponizing.

We have had no personal experience with Rhode Island Reds, but they are in strong favor with some poultrymen, many of them making the highest claims for them, though they are not yet admitted as a standard breed.

None of the black breeds are generally raised. They are not in demand for either broilers or roasters owing to the blue-white color of their flesh, and while Black Minorcas are good layers, they are not generally popular.

DISEASES OF CHICKENS.

We have had no epidemics among our poultry since we have been in the business. We keep our chickens in good health by the attention we give them. Their houses are cleaned three times each week, they are also fumigated once a week to kill and prevent vermin, they have dust boxes and a plenty of litter to scratch in, grit bone, charcoal and fresh water are constantly on hand. Their quarters are dry, well ventilated and they are well

fed. There are no causes for epidemics, and we do not have them. We, of course, lose chickens. In spite of good care and sanitary conditions, fowls will die occasionally of crop-bound or egg-bound, or of the disease known as "going light."

Colds, diarrhœa, distemper, roup, cholera, gapes, "going light," weak legs in young chicks and white combs are about all the diseases the average poultryman will be able to easily diagnose. Other obscure diseases, such as liver troubles, worms and indigestion are never discovered unless in post-mortem examination, and chickens dying of "liver troubles," etc., leave their death always a mystery with the average poultryman.

Chickens have not enough vitality to make doctoring successful. A very droopy chicken with diarrhœa we kill and burn, giving the rest of the flock a teaspoonful of the following mixture to a quart of water until cured:

1 oz. Laudanum.
1 oz. Tincture Capsicum.
1 oz. Tincture Camphor.
3 drs. Chloroform (pure).
5 drs. Alcohol.

This is a very powerful medicine, and care should be taken in its use. Discontinue as soon as the trouble is corrected.

For crop-bound give a half teaspoonful castor oil in water, hold chicken's head down and slowly work out contents of crop. Sometimes we have been successful in curing them by cutting open the crop and emptying it of its contents, washing it out and sewing it up. It is usually fatal, however.

Egg-bound is always fatal, and it is useless to doctor for it.

For colds we give aconite in drinking water, putting a dozen of the small pellets that are sold for this purpose in about a quart of water. Another excellent remedy is equal parts of cayenne pepper, ginger and mustard mixed in lard, rolled in flour and dropped down the chicken's throat. This usually cures in one night; if it should not, repeat the dose. Colds are usually detected by wheezing and rattling in the throat. The affected bird should always be treated, as it is liable to develop into something more serious. If there is any odor about the head with the cold we fear roup, and the unfortunate bird is killed and burned at once.

Experienced poultrymen do not doctor for roup, but kill and burn all affected fowls. However, here is a remedy some try who wish to save their birds:

1 oz. Oil of Sassafras.
1 oz. Jamaica Ginger.
1 oz. Tincture of Iron.
1 oz. Alcohol.
1-2 oz. Prickly Ash Fluid Extract.
1-4 oz. Oil of Anise.

Dose—Fifteen drops to one teaspoonful to each gallon of water.

The disease is known by the profuse discharge of an ill-smelling fluid from the mouth and nostrils. In treatment wash the head with a warm solution of one part carbolic acid to three parts water. Rinse out the mouth also and use a tooth-pick to remove the hard pieces of canker that form in the mouth. The disease is nearly always fatal, and when chickens do recover

from it they are seldom fit for breeding purposes. It is considered the great scourge of the poultry yard.

Cholera is always easily detected by the greenish-yellow discharges from the bowels, and the extreme weakness of the fowl. A dark purplish comb and extreme thirst always accompany this disease. The treatment is to kill the first bird affected. Remove the drinking pans, replacing with new ones, and give the following preparation at the rate of one tablespoonful to two gallons of soft food, or if preferred give in water, a tablespoonful to a gallon of water:

24 oz. Copperas.
1 oz. Blue Vitriol.
1 lb. Venetian Red.
1 oz. Nitrate of Potassium.

This is also a valuable tonic to give to well hens occasionally, and is one of the very best of the preparations for cholera.

Another remedy, or a prevention rather (for it is useless to doctor sick chickens), is to give 1-8 oz. sulpho-carbonate of zinc to a quart of drinking water.

The chief cause of the disease is unsanitary conditions. Chickens frequently have the disease after a hot spell of weather, followed by a long rainy spell. During such weather we use "the ounce of prevention," and give them the sulpho-carbonate of zinc in drinking water.

Distemper is a mild cold or fever, easily detected by the little fleck of froth that gathers in the corners of the eye. It is considered by many the forerunner of roup. Isolate and doctor as for cold.

Worms are seldom discovered unless found in post-mortem examinations. Give rest of flock a teaspoonful of turpentine to a quart of water, or in soft feed for every twenty chickens.

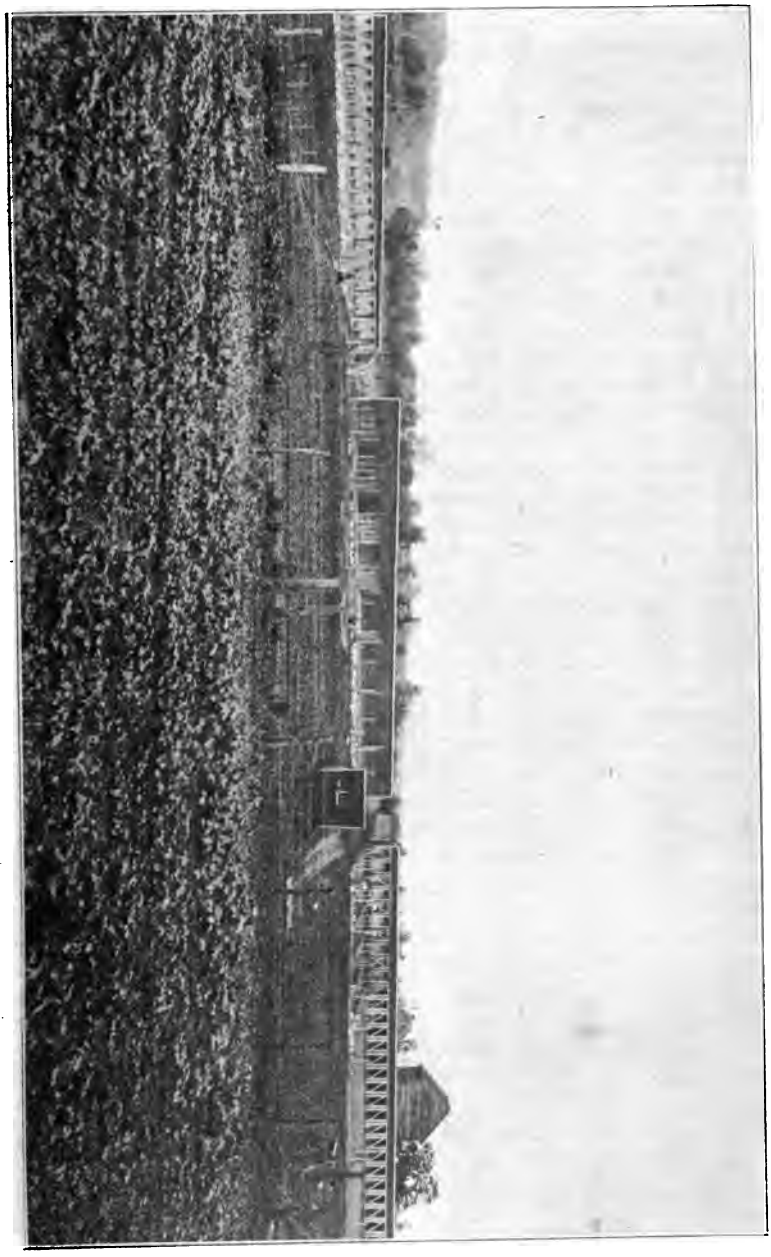
Weak legs affect young chickens chiefly, and the cause of the trouble is usually a bad spell of weather that prevents the chicks being turned out, or it comes from too high forcing when young, or from lack of bone food. Give them more exercise, feed less and give them plenty of bone.

Chickens reared artificially, and turned out in runs, very rarely have gapes. The trouble is generally supposed to come from the young chickens running on plowed ground.

There are two treatments: remove the worm by means of what is known as the "gape extractor" or place the affected bird in a large box with the top covered with coarse cloth, dust air-slacked lime on top of cloth. The lime breathed in will cause the worm in the wind-pipe to relax their hold and they are coughed up.

White combs indicate an impoverished state of the blood, usually caused from lice. Feed fifteen to twenty drops of tincture of iron to every quart of mash. Whitewash houses, fumigate with sulphur candles once a week, keep dust boxes full, in which air-slacked lime and sulphur have been mixed with the dust, or instead use insect powder. Spray corners and nests with crude petroleum, and persist in this course until they are exterminated.

Evening Meal in Summer Runs and Back View of Houses.



Bird's-Eye View of Laying and Breeding Houses.

POULTRY HOUSES.

Select a well drained location and face the houses either South or East, and the houses can be made warm, yet at the same time inexpensive. In addition if the houses be sheltered by other buildings or trees, this will be a great advantage. Under these circumstances if the houses are well stripped, inside sheeting can be done away with.

One point is important, build so the houses can be well ventilated. In our scratching pens we have storm doors. These doors are made by simply stretching unbleached cotton cloth over the door frames and tacking them down. When not in use they fasten by means of a hook in the top of the houses, and are out of the way until needed. They keep out the rain and wind in bad weather, yet at the same time admit plenty of fresh air.

Chicken manure is a valuable fertilizer, and should be saved. We do this by means of dropping boards. They are cheaper than entire floors of wood and take the place of floors very satisfactorily. We place our roost poles across one end of the house instead of scattering them around, having the dropping boards immediately beneath them. This saves the manure and makes the cleaning of houses very easy work.

Trap nests are so easily made and are so valuable in elimination of non-layers, that they should always be used. Dark nests are next best.

We think there is little to be said in favor of any special kind of houses. All that is necessary is that they be dry, warm and well ventilated.

TURKEY.

Turkeys are perhaps the least profitable fowls that a farmer can raise, but as returns from them come in a lump they retain their popularity.

The white Holland is a small, but very popular breed. Many breeders claim that it is more gentle than any of the other breeds.

The Bronze was originated by crossing the Narragansett females with the wild males, and although the cross has produced a magnificent bird that grows to an enormous size, they are such poor layers that they are not largely bred.

Turkeys will do nothing if reared and kept in confinement. They will not require any shelter, and to a large extent they will require little food, foraging for themselves. Birds for market will not suffer from close confinement and should be confined and fattened. If fed largely on corn they will quickly fatten and be much more tender than if fed on a mixture of grains.

The turkey hen will begin laying in March or April. They are, as a rule, not very prolific layers, twenty to twenty-five eggs a season being considered the average number of eggs laid. If the laying stock has been raised by the breeder, it is a good plan to begin from the first to feed them around the house, say the evening meal, for in this way they will not forage to any great distance, and can in some cases be induced to lay near at hand. Barrels sunk into the ground lengthwise and filled with straw, and covered with bushes and pine tops, will frequently be accepted by them for nests. If the eggs are to be set under the turkey hen, let them remain in the nest if

not likely to be disturbed, but if they are removed, replace with either stale hen eggs or china nest eggs, or the turkey may desert the nest without becoming broody. Scatter grain around so that she will not have to seek food at a distance and so get the eggs chilled. Do not disturb her until the hatch is over, when a good dry coop should be ready for her and her brood. It is well to have the coop in some kind of enclosure. At this age it is not well to let them forage to any extent, for getting wet either by dew or rain will cause them to die off. Under the best conditions young turkeys are very difficult to raise. Breeders now believe that the great mortality among young turkeys is due to bowel trouble that attacks them at about the second week. Some breeders claim that wheat screenings fed too heavily cause this trouble, and while a limited amount of wheat is of benefit to them, an exclusive diet of wheat will cause them to die out. All agree that bread mashes made up with skimmed milk or milk curds is a valuable food for them when very young. If they continue to die off very rapidly give them milk only to drink, in which add a few drops of the preparation that we advise for diarrhoea in chickens.

After the third week they become more hardy, and about the fifth week they begin to show red about the head; at this time, too, they begin to roost on heights, and low roost poles should be provided for them. From this time until the hatchet is used at Thanksgivings there will be few deaths. Feed heavily on corn a month before marketing.

Artificially hatched and reared turkeys are being sold at three and four pounds weight on the Northern markets, and the breeders claim that it is profitable, but as yet artificial incubation is largely in the experimental stage. Eggs are almost always hatched under the turkey hen or under hens.

As a usual thing not enough care is given to keeping the coops of young turkeys clean. Dirty coops breed a poison that is fatal to them.

DUCKS.

The Imperial Pekin is considered the best all-round duck for commercial purposes.

They are non-sitters and excellent layers, though they are seldom raised for egg production alone, though we do not know why. A good strain will lay about one hundred and forty to a hundred and fifty eggs during the season, and they can always be sold for cooking purposes. During March and April of the past year we sold their eggs at twenty-eight cents a dozen. They are much preferred to hen eggs by bakers.

Poultrymen disagree about whether they should be raised on water or not, but it is generally conceded that not more than fifty per cent. of the eggs will run fertile if raised away from the water. while if raised on water the fertility will run as high as eighty-five per cent. We are strongly in favor of the water method. Being aquatic birds, they are awkward on land. and swimming is to them what litter in the scratching pen is to the confined hen—it furnishes exercise.

Younger than two years old ducks do not hatch well, though yearlings make the best layers.

If fed for early eggs they should begin to lay early in January and continue well into July.

Ducks for market are almost entirely hatched in incubators. They hatch much better than chickens and at least ninety per cent. live that are hatched. They require warmth like young chickens for only about two weeks, when they are put out to swim and paddle around. At ten weeks old they are ready for market.

Early ducks known as "green ducks" bring fancy prices in Northern markets, and even as late as August they can be sold from a dollar to a dollar and twenty per pair in local markets. The cost of feeding them is much less than for feeding chickens the same length of time

The eggs are managed in the incubator just about like hen eggs, only they require four weeks of incubation, and after the first four days the eggs have to be cooled for about ten minutes night and morning.

Ducks graze like cattle, so should be kept in grassy lots. Their digestive apparatus is not suited for digesting grain, though they enjoy a little once in a while. They should be fed twice a day on a mash food made like the one given to hens. They will also require grit, oyster shell and charcoal, consuming about twice as much as the same number of chickens would.

The great thing in favor of duck raising is the fact that it is an extremely cheap business to start in. Thirty ducks and six drakes make a good start, and this number should enable a breeder to hatch out about three thousand ducks a season, and their care will amount to almost nothing.

Home Manufacture and Use of Unfermented Grape Juice.

INTRODUCTION.

Unfermented grape juice has no doubt been used ever since wine has been made from the grape. The following practical suggestions will enable housewives to put up unfermented juice at the time of the fruit harvest, and thus to utilize much fruit that is now annually lost through inability to preserve it in the fresh state. In this form it is a pleasant, wholesome drink and food well adapted to home use. On some farms enough such preventable wastes occur almost every year to largely reduce the possible profits, or even to cause failure to meet the running expenses of the farm. By preventing these wastes an unprofitable farm may often be made profitable.

In Europe physicians often send their patients to the wine-growing districts during vintage time to take daily rations of the fresh juice as it comes from the crusher. This, however, restricts its use to a brief season of the year and to the immediate vicinity of the vineyards, or to individuals who are yet strong enough to undertake the journey. Of late years repeated efforts have been made to prevent the juice from fermenting and to preserve it in vessels of such size and shape as can be easily transported, thus rendering its use possible at all times of the year. Until recently its use has been almost exclusively restricted to juice for medicinal or sacramental

purposes. Unrestricted and general use has been retarded through lack of knowledge of the principles underlying the process of manufacture. This lack of knowledge and of the necessary skill in applying it has resulted in many failures, thus rendering the production of a good article uncertain and expensive.

COMPOSITION OF THE GRAPE.

The grape contains 12 to 28 per cent. of sugar, about 2 to 3 per cent. of nitrogenous substances, and some tartaric and malic acids. The skins contain tannin, cream of tartar, and coloring matter. The seeds contain tannin, starchy matters, and fat. The stems contain tannin, diverse acids, and mucilaginous matter. The value of the juice made from any grape is determined by the relative proportion and composition of these various parts.

CAUSES OF FERMENTATION.

It is well known that grapes and other fruits when ripe have the invisible spores of various fungi, yeasts (ferments), and bacteria adhering to their skins and stems. When dry these spores are inert, but after the grapes are crushed and the spores are immersed in the juice they become active and begin to multiply. If the juice is warm, the changes take place rapidly; if, on the other hand, it is cool, the change is slower. But in either case, if left alone, the organisms increase until the juice ferments. The most favorable temperature for fermentation is between 65 degrees F. and 88 degrees F. Cold checks, but does not kill, the ferment. This fermentation, now commonly called the elliptic yeast, changes the sugar in the grape to alcohol and carbonic-acid gas, and is the leading factor in converting must into wine. Hence it will be readily seen that to keep grape juice sweet fermentation must be prevented, and to be salable the product must be clear, bright, and attractive.

METHODS OF PREVENTING FERMENTATION.

Fermentation may be prevented in either of two ways:

(1) By chemical methods, which consist in the addition of germ poisons or antiseptics, which either kill the germ or prevent their growth. Of these the principal ones used are salicylic, sulphurous, boracic, and benzoic acids, formalin, fluorides, and saccharin. As these substances are generally regarded as adulterants and injurious, their use is not recommended.

(2) Mechanical means are sometimes employed. The germs are either removed by some mechanical means, such as filtering or a centrifugal apparatus, or they are destroyed by heat, electricity, etc. Of these, heat has so far been found the most practical.

When a liquid is heated to a sufficiently high temperature all organisms in it are killed. The degree of heat required, however, differs not only with the particular kind of organism, but also with the liquid in which they are held. Time is also a factor. An organism may not be killed if heated to a high temperature and quickly cooled. If, however, the temperature is kept

at the same high degree for some time, it will be killed. It must also be borne in mind that fungi, including yeasts, exist in the growing and the resting states, the latter being much more resistant than the former. A characteristic of the fungi and their spores is their great resistance to heat when dry. In this state they can be heated to 212 degrees F. without being killed. The spores of the common mold are even more resistant. This should be well considered in sterilizing bottles and corks, which should be steamed to 240 degrees F. for at least fifteen minutes.

Practical tests so far made indicate that grape juice can be safely sterilized at from 165 degrees F. to 176 degrees F. At this temperature the flavor is hardly changed, while at a temperature much above 200 degrees F. it is. This is an important point, as the flavor and quality of the product depend on it.

This bulletin being intended for the farmer or the housewife only, the writer refers such readers as desire to go into the manufacture of grape juice in a systematic manner for commercial purposes to Bulletin 24, Bureau of Plant Industry, Department of Agriculture, on the same subject, this publication treating only of methods that can be applied in every home.

HOME MANUFACTURE.

Use only clean, sound, well-ripened but not over-ripe grapes. If an ordinary cider mill is at hand, it may be used for crushing and pressing, or the grapes may be crushed and pressed with the hands. If a light-colored juice is desired, put the crushed grapes in a cleanly washed cloth sack and tie up. Then either hang up securely and twist it or let two persons take hold, one on each end of the sack, and twist until the greater part of the juice is expressed. Then gradually heat the juice in a double boiler or a large stone jar in a pan of hot water, so that the juice does not come in direct contact with the fire, at a temperature of 180 degrees F. to 200 degrees F.; never above 200 degrees F. It is best to use a thermometer, but if there be none at hand heat the juice until it steams, but do not allow it to boil. Put it in a glass or enameled vessel to settle for twenty-four hours; carefully drain the juice from the sediment, and run it through several thicknesses of clean flannel, or a conic filter made from woolen cloth or felt may be used. This filter is fixed to a hoop of iron, which can be suspended wherever necessary. After this fill into clean bottles. Do not fill entirely, but leave room for the liquid to expand when again heated. Fit a thin board over the bottom of an ordinary wash boiler, set the filled bottles (ordinary glass fruit jars are just as good) in it, fill in with water around the bottles to within about an inch of the tops, and gradually heat until it is about to simmer. Then take the bottles out and cork or seal immediately. It is a good idea to take the further precaution of sealing the corks over with sealing wax or paraffin to prevent mold germs from entering through the corks. Should it be desired to make a red juice, heat the crushed grapes to not above 200 degrees F., strain through a clean cloth or drip bag (no pressure should be used), set away to cool and settle, and proceed the same as with light-colored juice. Many people do not even go to the trouble of letting the juice settle after straining it, but reheat and seal it up imme-

diately, simply setting the vessels away in a cool place in an upright position where they will be undisturbed. The juice is thus allowed to settle, and when wanted for use the clear juice is simply taken off the sediment. Any person familiar with the process of canning fruit can also preserve grape juice, for the principles involved are identical.

One of the leading defects so far found in unfermented juice is that much of it is not clear, a condition which very much detracts fom its otherwise attractive appearance and due to two causes already alluded to. Either the final sterilization in bottles has been at a higher temperature than the preceding one, or the juice has not been properly filtered or has not been filtered at all. In other cases the juice has been sterilized at such a high temperature that it has a disagreeable scorched taste. It should be remembered that attempts to sterilize at a temperature above 195 degrees F. are dangerous, so far as the flavor of the finished product is concerned.

Another serious mistake is sometimes made by putting the juice into bottles so large that much of it becomes spoiled before it is used after the bottles are opened. Unfermented grape juice properly made and bottled will keep indefinitely, if it is not exposed to the atmosphere or mold germs; but when a bottle is once opened it should, like canned goods, be used as soon as possible, to keep it from spoiling.

USES OF UNFERMENTED GRAPE JUICE.

The uses are indeed many. It is used in sickness, convalescence, and good health; as a preventative, restorative, and cure; by the young, by persons in the prime of life, and by those in old age. It is used in churches for sacramental purposes; at soda fountains as a cool and refreshing drink; in homes, at hotels, and at restaurants as a food, as a beverage, as a dessert, and in many other ways. When people become accustomed to it they rarely give it up. When properly prepared, unfermented grape juice can be made to please the eye by its color and attractive appearance, the sense of smell by its aroma or fragrance, the palate by its pleasant flavor.

It is food and drink, refreshment and nourishment, all in one. Not a by-product, but made from fruit going to waste—one of the blessings given us, that some are too careless, others too ignorant, to make use of.

FOOD VALUE OF UNFERMENTED GRAPE JUICE.

The effects of unfermented grape juice on the human system have been studied for a number of years, especially at the so-called grape cures so long in vogue in Europe. A smaller number of investigations have been made in laboratories.

It is quite generally claimed that using a reasonably large amount of unfermented grape juice with an otherwise suitable mixed diet is beneficial and that digestion is improved, intestinal fermentation diminished, and that gains in body weight result. It should not be forgotten that the abundant diet and hygienic methods of living practiced at the grape cures play an important part, but even taking all this into account it seems fair to conclude that some of the good results can be directly attributed to the unfermented grape juice.

Grape juice contains the same kinds of nutrients as other foods. The percentage of water is high, and thus it resembles liquid foods more closely than solid foods. It is sometimes compared with milk, the most common liquid food. It contains less water than milk, more carbohydrates, and less protein, fat, and ash. Carbohydrates, largely present in the form of sugar, are the principal nutritive ingredients. It is evident, therefore, that grape juice is essentially an energy yielding food, and may help the body to become fatter, though it cannot materially assist in building nitrogenous tissue. Sugars in moderate amounts are wholesome foods, and grape juice offers such material in a reasonably dilute as well as palatable form. Undoubtedly the agreeable flavor increases the appetite, a by no means unimportant consideration.—*Extrs. Farmers Bul.* 175.

The Farmer's Home Grounds.

If the farmer desires to sell his farm, nothing will bring him a buyer quicker than neat, clean, attractive grounds around his dwelling. Fifty dollars spent in the proper improvement of his surroundings will add five hundred dollars or more to the selling price and make a quicker sale. But if he does not wish to sell his home, some adornment of his lawn or yard will add greatly to enjoyment of "sweet home" to himself and his family, especially will the wife and daughters appreciate this. Nothing can take the place of the cool shade trees, the thrifty shrubbery and the beautiful roses and flowers that embellish a country home. They are the expressions of restfulness, of beauty and contentment. To have these requires but little money and labor if properly directed. To aid and encourage this much-felt need of improvement around many of our country and village homes these suggestions are given. Man should first provide for his necessities, then for comforts, and then for his pleasures. Many who would like to begin these improvements do not know exactly what to do or what to plant. The following suggestions are made. For shade trees any of the following are desirable. Many varieties should be used for best effect, and not set in rows. Put single trees in isolated positions or irregular groups:

Sycamore maple,
Scarlet maple,
Tulip tree,
Norway spruce,
Double-flowered horse chestnut,
Golden weeping willow,
American linden,
American elm,
European white birch.

SHRUBS.

Double-rose of sharon,
Gordon's mock orange,
Arrow-wood maple leaved,
Hardy hydrangea,
Weigela,
White Siberian lilac,
Japanese snowball,
Deutzia's double rosy,

Shrubs should be planted in groups of three—against a background is preferable.

VINES.

Boston ivy,
Virginia creeper,
Chinese wisteria,
Trellis or climbing roses,
Riene Marie Henriette,
Gardenia,
Ard's rover,
Queen Alexandria,
Crimson Rambler,
Lord Penzance.

HYBRID TEA ROSES—ALL SUMMER BLOOMERS.

Killearney,
Caroline Teslout,
Antoine Revoir,
La France,
Ellen Wilmot,
Hybrid perpetual roses.

White.

Mervulle de Lyon,
White Baroness,
Margaret Dickson,
Mable Morrison,
Gloire Lyonnaise.

Pink.

Baroness Rothschild,
Caroline d' Arden,
Her Majesty,
Paul Neron.

Crimson and Carmine

Captain Hayword,
Duke of Edenburg,
Duke of Teck
Gen Jacquiminot,

Very Dark Rose.

Prince Carmille de Rohan,
Sultan Zanzibar,
Louis Van Houtte.

SOME PRACTICAL HELP IN GROWING ROSES.

The most important matter in growing roses is a good location, which should be airy, but sheltered to some extent; keep away from large trees; wet land does not suit roses. Dig a hole two feet wide and eighteen inches deep, fill with rich top soil. This should be done some weeks before setting the rose. Here is an important point in growing roses: suit the soil to the class of roses grown. The hybrid perpetual roses require more clay, or a heavy soil. The tea rose wants a lighter soil—one with more sand. Remember that well-rotted manure should always be put in the bottom of the hole, so the young roots will not come in contact with it until the rose has become well established. The roots should not be crowded, and the point where the rose was budded should be put between two and three inches under the surface of the soil. Pack the soil, as the roots are covered very firm. This is important, but put one inch of loose soil on the surface.

If potted roses are planted, get them out as soon as frosts are over in the spring, as late planted roses will not withstand the heat of summer.

Pruning may be done in March. All weak stems should be cut out and the healthy ones cut back to about eight inches. Always cut just above a node. The highest bud left will start to grow in the direction the bud points,

Pruned in spring for quality of bloom.
A Hybrid Perpetual rose. Twelve canes from six to eight inches long, each cut above an outside bud.

The same bush eight months later.
Showing that severe pruning does not check growth.
Also how bushy tops should be cut back in autumn.

so let the last bud point in the direction you want it to grow. The worst enemy of the rose is the rose beetle. They should be looked for daily after they make their appearance and picked off. This is the only remedy. Slugs are usually found on the under side of the leaves. A solution made with two tablespoonsful of white hellebore in three or four gallons of boiling

water. When ool sprinkle by throwing the solution up under the leaves by a whisp broom or watering can. Alphis is a common pest to the rose grower. Sprinkle with a tobacco solution with a small portion of whale oil soap dissolved in it. The bark louse should be sprinkled with a solution of strong soap suds. This will not always kill, but is a good remedy. Rub the stems with an old tooth-brush and soap suds. If mildew appears after much damp weather, sprinkle when dew is on with dry sulphur and renew if washed off by rain.

CULTIVATION.

Roses should be cultivated by keeping the soil loose around the roots, and if watered with liquid manure when the buds first appear splendid results will be obtained, or sprinkle several tablespoonsful of nitrate of soda around each bush, and water it in the soil.

DISBUDDING.

Some roses put out a number of buds at the end of the shoot. If some of these are pinched off, much larger roses will bloom. If extra roses are desired, take off all but one bud.

FALL PRUNING.

Before cold weather cut off the tall stems to prevent the wind whipping them all winter and loosen the roots. A covering of manure should be given the roots or straw of some kind to prevent hard freezing. Many a lady who loves the rose, the queen of flowers, will appreciate these plain, plactical suggestions on rose culture and be encouraged to grow them.

Charlotte County Road Improvement.

BY C. E. DICKINSON, HIGHWAY ENGINEER.

Photographs by the Author.

Good, bad and indifferent roads have been written up for years. Political campaigns have been waged on this issue. National as well as State aid have been promised, and the country people, whom it concerns the most, will look with careful glance along the line to see if those who have won out will so soon forget their promises made in every city and hamlet in the State, or will they allow the farming class to fight it out the best they can from such as they have.

Road construction is not generally understood. Where a community is called upon to vote a bond issue, they are expected to foster a scheme which is foreign to existing conditions, and which they know absolutely nothing about, therefore are they to blame for a lack of active interest in the proposed improvement. Place literature on the subject where it will do the most good, that those who drive may also read; the rest will follow in time. Additional taxation seems to be the stumbling block. Some States gives the

right to assess for road purposes to the extent of one-half of one per cent. upon their ratables. This does not include the State's appropriation. New York State pays 50 per cent. of the cost; counties, 35 per cent., cities and towns the remainder, and so on with other States. This method of additional taxation where in vogue is not considered a burden. It is but just that the cities and towns should be taxed for road purposes, as they reap the benefit of the produce transported along the highways at all seasons of the year.

WHOM TO TAX.

It is useless to expect the great railway corporations to assist voluntarily or otherwise in the good work. They selfishly recognize the fact that they

will get all the freight that is coming their way, good roads or no good roads; and yet without the farmers' produce they would soon go into bankruptcy. Tax the railroads.

Saw-mill concerns, the great "destructors" of good thoroughfares, should also be required to pay a special tax, and not be allowed to move from county to county, to ship from mill to station, and rut the roads up to the hubs and go "scott free."

The wood-working corporations, with office and factory, and mill beyond the borders of the State working up heavy timber from the stump—they should be required to pay a small proportion of the cost—pay for the privilege of hauling heavy logs from woods to station to be shipped to another State, cutting up and destroying the farmers' outlet; and our lawmakers, going into office on the good-road platform, professing great love for the farming class, should see to this and legislate accordingly.

Eggleston's Lane, a County Road, Before Improvement, in Charlotte County.

Charlotte county has spent in the past thirty years on an average of one thousand dollars per annum trying to make passable the five-mile stretch of road from Drakes' Branch to Charlotte Courthouse. A clear loss of the interest at 6 per cent. on half a million dollars for one year. Nothing to show for it except as bad a piece of road as can be found in any community. The county, while not the largest nor the richest in the State, still has but one idea, and that is, up and onward. Her people are progressive, and growing weary of a century of mud and mire, have built within the year five miles of up-to-date macadam road, from Drakes Branch to Charlotte Courthouse, an object lesson in progression which other counties would do well to copy. The road is a fact, built along modern lines—ten feet of macadam in three thickness, is of stone from dust to three inches in size, with three feet of earth shoulders on each side, making a total width of sixteen feet. Each step in construction has been carefully watched by the road commissioners and people alike. Now that they see what goes to make a good macadam road, they do not consider a little extra taxation a burden, but are willing to go it one better. For the construction of the above named road the county voted a bond issue, secured the money—$15,000—furnished the stone and rights of way, which, through the liberality of the property owners, cost nothing. The contractor, W. D. Adams, Jr., of Lynchburg, broke up the stone, hauled the same to the crusher, where it was crushed and screened for the road-bed proper, hauled out, spread and rolled down to a thickness of ten inches by a twelve-ton steam roller. No bridges, no culverts. Four-inch terra cotta pipe were used for lateral drains. Terra cotta sewer pipe as high as eighteen inches in diameter were used for cross drains, cutting out the wooden boxes. Filling in holes and ruts and general grading was done at the contractor's expense. The stone is locally called "nigger head," a true trap rock of great density, so called because having resisted from their greater hardness the abrading influences which have destroyed the softer sedimentary strata, an important section of the intrusive rocks igneous, or otherwise, associated with stratas of all ages.

REPAIRS.

Keeping in good repair. Stone roads is an important feature not to be omitted. When a rut occurs fill it in as soon as possible with crushed stone ranging in size from one-half inch to three-fourths inch. When spread the full width of the road and about an inch deep it will not require rolling. The point of contact will be so near the point of resistance that the full crushing force of the hoof, or the weight of the load upon the wheel, will fracture the stone, causing it to yield a small amount of dust, which is protected, and is not readily blown off. Ordinary travel will in time reduce all of this, of course, and protect the road-bed. As to the cost of maintenance of way, much depends upon local conditions. When hard blue trap rock is used, and ordinary country travel prevails, forty dollars per mile is a safe estimate. If the softer limestones are used, the wear is very much greater, and the cost of repairs proportionally increased. The above figure is based upon labor at $1.25 per diem, teams at $3.00, and stone at $1.25 per ton delivered on the road. I hope the day is not far distant when every county in the State will

recognize the value of good highways and construct a few miles each year. Where the same have been built farm values have improved, and life made pleasanter and happier for the owner of the land.

Pure Food Analysis.

BAKING POWDERS.

[Extracts from Pure Food Bulletin No. 23. This bulletin will be sent to any one on request.]

By E. W. Magruder and H. H. Hurt.

The leavening of bread products, whether by yeast or baking powders, is accomplished by an evolution through the whole mass of dough of carbonic acid gas, which in escaping makes the baking bread light and porous.

Yeast introduced into the bread, microscopic plants which cause the fermentation of the sugars originally present, or formed during the process; these are split up into carbonic acid and alcohol, both of which escape, in large part, if not entirely, during baking, and the yeast plants are all killed during the process.

Baking powder, on the other hand, evolves carbonic acid gas in the dough, by the chemical reaction of soda with some acid material, or material which acts as an acid, and leaves in the bread the non-volatile products of the reaction.

Similar chemical action results when soda is used by the cook with cream of tartar or sour milk.

CONSTITUENTS OF BAKING POWDERS.

Two ingredients are necessary in a baking powder: (1) A carbonate which contains the carbonic acid necessary to raise the dough, and (2) an acid constituent or its equivalent, which in the presence of moisture liberates carbonic acid gas from the carbonate. Nearly every brand on the market also contains a "filler" which is to keep it dry and prevent the decomposition of the powder before it is used.

(1) *Bicarbonate of Soda.*—The chief, and in nearly every case, the only source of the carbonic acid gas in the baking powder is bicarbonate of soda, also known as cooking soda. Pure bicarbonate of soda contains about 52 per cent. of carbonic acid gas.

Filler.—A harmless material, such as flour or starch, in a baking powder of good leavening power is not regarded as an adulterant, but rather as a material necessary for the proper keeping of the product. It is claimed, however, that starch is not necessary if the powder is properly put up in a dry climate.

Sulphate of lime (gypsum or land plaster), which in small amounts is unavoidably introduced into phosphate and alum phosphate powders, as an impurity of the acid phosphate, is separately added as a filling material at

Eggleston's Lane, After Improvement, in Charlotte County.

times. It is very slightly soluble in water, and, although it has no decided medicinal properties, it is a very undesirable addition to food products.

Other minerals, such as ground talc, are sometimes used as fillers. Filling materials which are legitimate are sometimes added in excess, thus reducing the efficiency of the powder. They are then adulterants.

Acid Material.—The chemicals used to liberate gas from the bicarbonate may be: (1) A true acid (tartaric acid); (2) an acid salt (cream of tartar, acid phosphate, etc.), or (3) a neutral salt (alums, aluminum sulphate, etc.). A consideration of these acid materials and the residue left after their reaction with the bicarbonate of soda is essential for a proper understanding of the wholesomeness of the powders in which they are used.

The efficiency of a powder as a leavening agent depends on the amount of gas it liberates in the dough, and must be considered apart from the wholesomeness of the residues.

CLASSES OF BAKING POWDERS.

Baking powders are best classified according to the acid constituents they contain, as follows:

Tartrate powders, in which the acid is tartaric in some form.

Phosphate powders, in which the acid is phosphoric.

Alum powders, in which the acid is sulphuric, combined in some alum salt.

Alum-phosphate powders, a mixture of the two just mentioned, in which the acid is both sulphuric and phosphoric.

Tartaric Acid Baking Powders.—Tartaric acid is a colorless crystalline solid, readily soluble in water. It is the chief acid constituent of grapes, and is contained in all grape wines. It is prepared from the settlings of wine casks, known as argol. The residue left in bread prepared with a tartaric acid powder is sodium tartrate, which is a salt, acting with a power equal to that of magnesium sulphate (Epsom salts) in the dose of ten drachms (1¼ ounces) (U. S. Dispensatory). A dozen biscuit made with a quart of flour and two teaspoonfuls of a good tartrate powder contain about one-fifteenth of an ounce of sodium tartrate, or less than one-tenth of a medicinal dose.

Cream of Tartar Baking Powders.—Cream of tartar, also known as bitartrate of potash, or acid tartrate of potash, is a colorless crystalline acid salt, and, unlike tartaric acid, is not readily soluble in water. It is the chief ingredient of argol, from which it is prepared by recrystallization. The material left in bread made with cream of tartar baking powder is the nonvolatile compound sodium-potassium tartrate, or Rochelle salt, which, in doses of from half an ounce to an ounce, is a mild, cooling purgative, well suited to delicate and irritable stomachs (U. S. Dispensatory). A dozen biscuit made from a quart of flour and two teaspoonfuls of tartrate baking powder contain about one-sixth ounce of Rochelle salt, or less than one-quarter of the average dose.

Phosphate Baking Powders.—The acid ingredient of these powders is a purified acid phosphate of lime, commonly obtained by the action of sulphuric acid on some form of phosphate of lime. It usually contains a certain amount of sulphate of lime, as an impurity incidental to the process of manufacture.

The residues left in the bread by a phosphate powder are phosphate of lime, phosphate of soda, and sulphate of lime (when this latter is an impurity in the acid phosphate of lime). The phosphate of lime left in the bread is almost insoluble in water, but soluble in dilute mineral acids, and probably in the gastric juice of the stomach. It is not used medicinally.

Phosphate of soda is a colorless crystalline solid, readily soluble in water. In doses of from one to two ounces it is a mild purgative, and well adapted to children and persons of delicate stomach (U. S. Dispensatory). Sulphate of lime is not used internally in medicine.

Twelve biscuit made from one quart of flour and two teaspoonfuls of a good phosphate baking powder would contain about one-sixth of an ounce of phosphate of soda, about one-ninth of an average dose, together with variable amounts of phosphate of lime and sulphate of lime.

Alum Baking Powders.—The acid material in alum baking powders is furnished by one of the salts known as alums, which are known as the double sulphates of aluminum and an alkali. Three of these double salts, known as potash-alum, ammonia-alum and soda-alum, have been used, but at present soda-alum, is usually employed.

"Alum is a powerful astringent, with very decided irritant qualities, owing to which, when taken internally in sufficient quantity, it is emetic and purgative, and may even cause fatal gastro-intestinal inflammation." (U. S. Dispensatory.) In a properly made baking powder the alum should all be decomposed during the baking of the bread.

The residue left in the bread from an alum powder depends on the kind of alum used. If soda-alum is used, the residue would be sodium sulphate (Glauber's salts) and aluminum hydroxide. "Sodium sulphate in doses of from half an ounce to an ounce is an efficient hydragogue cathartic; in smaller doses an aperient and diuretic." (U. S. Dispensatory.) Aluminum hydroxide is a white, light amorphous powder. It is very feebly astringent and dissicant, and in medicine sometimes used externally, but not internally (U. S. D.).

Twelve biscuit made from a quart of flour and two teaspoonfuls of a good alum baking powder would contain about seven and one-half grains of aluminum hydroxide and one-eighth ounce of sodium sulphate (Glauber's salts), about one-sixth of an average dose.

Alum-Phosphate Baking Powders.—Some powders contain more than one acid ingredient, the most important being those which contain both alum and phosphate.

The residues left in bread by alum-phosphate baking powders consist of a mixture of the residues already referred to as being present in bread when alum and phosphate powders are used separately, together with a small amount of aluminum phosphate. Aluminum phosphate is insoluble in water, but soluble in dilute mineral acids, and, presumably, to some extent, at least, in the gastric juice. It is not used in medicine.

On account of the variable composition of alum-phosphate powders no satisfactory estimate can be made of the amounts of the salts left in the bread.

General Remarks.—As to which is the best, or, rather, least undesirable, baking powder, there has been, and is, much discussion, and wide and honest differences of opinion exist. All, without exception, leave in the bread certain salts named in the preceding paragraphs, which are foreign to the flour,

and most of which are used in medicine. It stands to reason that, if it were not for convenience, the introduction of these salts into food would be condemned, because of the medicinal effects on the system. It must also be borne in mind that, if the powders are not properly made, or if, in baking, the powders are not completely decomposed, then some of the original materials used to make the powders will be left in the bread, and will produce some effect on the system appropriate to each.

Every package of powder should be plainly labeled, stating what kind of powder it is, and guaranteeing the percentage of carbonic acid gas it will liberate. This is required by the regulation published on page 19.

With all baking powder properly labeled, each individual can purchase intelligently, according to the dictates of taste, inclination or judgment.

EXAMINATION OF BAKING POWDERS SAMPLED.

Twelve samples of baking powders were examined, classified as follows:

	No. of Brands.
Tartrate powders	2
Phosphate powders	2
Alum powders	5
Alum-phosphate powders	3

In the table which follows are given the results of the examination of these baking powders.

Both of the tartrate powders, Nos. 113 and 117, had a statement on them that they were pure tartrate powders.

Of the phosphate powders, No. 118 claimed to contain a "cream of tartar substitute," and No. 119 claimed to be a strictly pure phosphate powder.

None of the alum powders or alum-phosphate powders had any statement as to what were the ingredients used. No. 110 guaranteed every package to give perfect satisfaction; No. 121 is "conscientiously recommended to consumers for purity and excellence"; No. 114 is guaranteed to be pure and wholesome, and the makers of No. 115 have "carefully considered the health of yourself and that of your family"; hence "fully guarantee the strict purity of every ingredient it contains."

Guaranteeing the ingredients to be pure amounts to nothing, unless it is stated what the ingredients are, for *strictly pure* strychnine might be put in, and the guarantee would still be true, but the powder would be a *very* undesirable one.

All of the powders except No. 113 contained starch.

The real efficiency of a baking powder depends on the amount of carbonic acid gas which it will liberate during the baking of the bread, and that amount should be guaranteed on each package, just as each bag of fertilizer is required to have printed on it a statement, guaranteeing the amount of valuable constituents it contains. Only one of these samples, No. 113, bore any guarantee of the amount of gas it would liberate, and this was 3.64 per cent. more than it actually contained, as can be seen by referring to the accompanying table. On No. 114 was the statement that it would liberate 3 per cent. more carbonic acid gas "than any other powder made," which is not the case, as can be readily seen from the tables. On none of the other packages was there a statement as to how much gas their contents would give off.

A baking powder of good leavening power should supply about 12 per cent. of carbonic acid gas. Most of the powders, as is shown by the table, were of good leavening power, some running up very high. Two, however, Nos. 119 and 115, were very low indeed. This may have been due either to carelessness in making or to the unavoidable deterioration of the baking powders due to age. The loss to the purchaser would be, however, the same, as it would take from two to three times as much of these powders to accomplish the desired result, or, if the usual amount were used, the bread would be a failure.

RESULTS OF THE EXAMINATION OF BAKING POWDERS.

TARTRATE BAKING POWDERS.

Laboratory No.	Name of Brand.	Name and Address of Manufacturer.	From Whom and Where Collected.	Price per Package—Cents.	Available Carbonic Acid Gas. Found—Per Cent.	Available Carbonic Acid Gas. Guaranteed—Per Cent.	Remarks.
113	Hazard.	E. C. Hazard & Co., New York, N. Y.	R. S. Christian & Co.. Richmond, Va.	20	11 . 96	15 . 60	Contains no starch.
117	Royal.	Royal Baking Powder Co., New York, N. Y.	R. S. Christian & Co., Richmond, Va.	25	12 . 54	. . . .	Corn starch.

PHOSPHATE BAKING POWDERS.

118	Horsford's Self-Raising Bread Preparation . .	Rumford Chemical Works, Providence, R. I	E. Turner & Co., Charlottesville, Va. . .	10	15 . 76	. . . .	Corn starch.
119	Rumford's	Rumford Chemical Works, Providence, R. I	R. S. Christian & Co., Richmond, Va.	10	4 . 33	. . . .	" "

ALUM BAKING POWDERS.

110	Blue Ribbon	The Blue Ribbon Baking Powder Co., Richmond, Va.	T. J. Wills Co., Charlottesville, Va	10	11.24	....	Corn starch.
112	Winner.	J. D. & R. S. Christian Co., Richmond, Va.	S. Hirsh, Fredericksburg, Va	5	16.30	....	Wheat "
116	Patapsco.	Patapsco Baking Powder Co., Baltimore, Md.	S. Hirsh, Fredericksburg, Va	5	12.14	....	Corn "
120	Good Luck.	Southern Manufacturing Co., Richmond, Va.	R. S. Christian & Co., Richmond, Va.	5	15.33	....	" "
121	Bob White	The Sea Gull Specialty Co., Baltimore, Md., and New Orleans, La	T. J. Wills Co., Charlottesville, Va	5	16.86	....	" "

ALUM-PHOSPHATE BAKING POWDERS.

111	Rex (one spoon)	J. D. & R. S. Christian Co., Richmond. Va.	T. J. Wills Co., Charlottesville, Va	5	14.52	....	Corn starch.
114	Alderney.	Kenton Baking Powder Co., Cincinnati, O.	Morris Grocery Co., Roanoke, Va.	10	12.53	....	" "
115	Your Friend	Johnson Pickle Co., Richmond, Va.	R. S. Christian & Co., Richmond, Va.	5	5.81	....	" "

MOLASSES AND SIRUPS.

BY E. W. MAGRUDER.

Molasses, sirup and glucose are mixed together in all proportions and sold as pure molasses, or pure sirup, or under some one of a great variety of trade names, some of which deceive while others do not.

The terms molasses and sirup are very loosely used at present, and are applied to almost any sweet substance of a sirupy consistency.

The terms molasses, sirup and glucose may be properly defined as follows:

Sirup is the product made by purifying and evaporating the juice of a sugar-producing plant without removing any of the sugar.

Molasses is the product left after separating the crystallizable sugar from the purified juice of a sugar-producing plant.

Glucose is a thick, sirupy, colorless product, made by incompletely hydralizing starch or a starch-containing substance, and decolorizing and evaporating the product.

Glucose is about half as sweet as cane sugar, and when properly made is a wholesome article of food.

In manufacturing and refining cane sugar (or *sucrose*) some of the sugar becomes what is called inverted and forms invert sugar, which is a mixture of equal parts of dextrose (or glucose) and levulos (or fruit sugar). These materials are difficult to crystallize, so that when the cane sugar crystallizes, they together with more or less of the cane sugar, remain uncrystallized and form molasses.

The object of the manufacturer is to obtain as large an amount of sucrose, or cane sugar, as possible, and, as by modern methods, a greater proportion of sucrose, or cane sugar, is obtained, in the same proportion does his by-product molasses deteriorate.

In many parts of the Gulf States the purified juice of the sugar cane is evaporated to a sirupy consistency, and put on the market without having any of the sugar removed; this is frequently called cane sirup, and is a most excellent table sirup.

Sorghum sirup is made in a similar manner by evaporating the juice of the sorghum plant to a sirupy consistency without removing any sugar.

Maple sirup is similarly made by evaporating the sap of the sugar maple to a sirupy consistency without removing any of the sugar. Or it may be made by dissolving the maple sugar in the proper amount of water.

When glucose is added to molasses, cane sirup, sorghum sirup, or maple sirup, without the fact being made known, or when these articles are sold as pure of their kind, and have glucose added to them, they must, of course, be considered adulterated. It is, however, prefectly lawful and proper to mix glucose with any of these substances: *provided* the fact is made known in such a way that there would be no chance of deception. In other words, the article should be properly branded or labeled as prescribed on page 19.

RESULTS OF THE EXAMINATION.

In the following table the results of the examination of eighteen samples of molasses and sirups are given.

In the table under the columns marked Polarization, the reading of the polariscope on properly prepared solutions of the materials directly, and then after inversion, is given. From the figures thus obtained the amount of sucrose, or cane sugar, is calculated and the presence of glucose determined.

It will be seen that more than half contained glucose, and in only one case did the name imply, or was there a statement, that any glucose was present.

Sample No. 231, New Orleans molasses, contained a small amount of glucose. Nos. 229, 233, and 234 all contained a large per cent. of glucose. No. 239, sorghum molasses, also contained much glucose. No. 229, rock candy sirup, by its name, would lead one to think that it was made from rock candy, which is very pure sucrose, or cane sugar, and that it contained no glucose at all; instead of which it is nothing but glucose with a very little molasses or sucrose sirup added. Nos. 226, 238, and 242, the names of which would indicate that they were made from sucrose, without any glucose at all, are in reality nothing but glucose with a little molasses or sucrose material added. No. 227, "Karo Corn Sirup," has this statement on the can "Composed of 85 per cent. corn sirup and 15 per cent. cane sirup." The label on this sample is not calculated to deceive in any way. The name itself, "Karo Corn Sirup," shows that it is made from corn and not from any of the sugar-producing plants, and besides this indicative name there is a statement as to the ingredients. The sample had, however, either a little less cane sirup than was claimed or else the cane sirup was weak. This, however, is a good example of how branding and labeling should be done.

RESULTS OF THE EXAMINATION OF MOLASSES AND SIRUPS.

Laboratory No.	Name of Brand.	Name and Address of Manufacturer or Wholesaler.	From Whom and Where Collected.	Price Per Gallon, Cents.	Polarization. Temperature.	Polarization. Direct.	Polarization. After Inversion.	Sucrose, or Cane Sugar. Per Cent.	Remarks.
230	Red River Louisiana Baking Molasses	P. Duff & Sons, Pittsburg, Pa	Morris Grocery Co., Roanoke, Va	80	28°	12.4	−14.3	20.54	Not found adulterated.
231	New Orleans Molasses	Dugue & Son, New Orleans, La	R. L. Christian & Co., Richmond, Va.	80	29°	50.4	−12.3	48.42	Small amount of glucose added.
232	New Orleans Syrup	T. H. Liggett, New York, N. Y.	T. J. Wills Co., Charlottesville, Va	60	29°	48.5	−16.3	50.04	Not found adulterated.
228	Maple Syrup	Crystal Conserve Co., New York, N. Y.	W. L. Brannon, Fredericksburg, Va	100	28°	47.	18.5	50.38	" " "
240	Maple Sap Syrup	Welch Bros. Maple Co., Burlington, Vt	W. L. Brannon, Fredericksburg, Va	100	26°	63.5	−20.0	63.75	" " "
241	Maple Syrup	L. G. Yoe & Co., Chicago, Ill	W. O. Johnson, Lynchburg, Va		30°	60.7	−17.8	60.85	" " "
229	Palmetto Molasses	P. Duff & Sons, Pittsburg, Pa	Morris Grocery Co., Roanoke, Va.	60	28°	82.4	55.	21.08	Adulterated with glucose.
233	Rockwood Molasses	Hearn & Jones, New Orleans, La	W. O. Johnson, Lynchburg, Va		29°	93.45	60,90	25.13	" " "
234	Porto Rico Imported	H. L. Hobard & Co., New York, N. Y.	R. L. Christian & Co., Richmond, Va.	50	26°	59.1	44.7	33.89	" " "
236	Molasses	Michie Grocery Co., Charlottesville, Va.	T. J. Wills, Charlottesville, Va	30	26°	32.0	14.5	35.63	Not found adulterated.
235	Sorghum Molasses	W. C. Leake, Proffit, Va.	E. Turner Co., Charlottesville, Va	50	26°	49.1	9.0	44.52	
237	Tennessee Sorghum	National Molasses Co., St. Louis, Mo	W. O. Johnson, Lynchburg, Va		26°	27.4	114.1	32.18	Low grade.
239	Sorghum Molasses	E. A. Saunders Sons, Richmond, Va.	T. J. Wills, Charlottesville, Va	40	26°	76.55	39.6	28.64	Adulterated with glucose.
225	Rock Candy Syrup	Barrow Penn & Co., Roanoke, Va.	Morris Grocery Co., Roanoke, Va.		28°	124.4	112.1	9.46	Glucose with a little molasses added.
226	Old Folks' Syrup	Charles King & Son., Roanoke, Va.	J. D. Watson, Charlottesville, Va		29°	145.6	141.5	3.17	" " "
227	Karocorn Syrup	Corn Products Co., Chicago, Ill	W. O. Johnson, Lynchburg, Va		28°	140.0	137.4	2.0	" " "
238	No. 2 Silver Drip Syrup	E. A. Saunders Sons, Richmond. Va.	E. Turner, Charlottesville, Va	50	26°	126.8	116.5	7.09	" " "
242	Paragon Honey Syrup	L. G. Yoe & Co., Chicago, Ill	W. O. Johnson, Lynchburg, Va		30°	127.7	117.3	8.06	" " "

COMMERCIAL STOCK FEEDS.

By E. W. Magruder, H. H. Hurt and C. M. Bradbury.

In the table following will be given the results of the chemical analysis and microscopical examination of thirty-four samples of commercial stock feeds, consisting of wheat bran, cotton seed meal, midlings, corn feed, oat feed, mixed feeds, gluten feed and flax seed meal.

In the first part of the table is given the average composition of these various materials when pure, as given in the publications of the United States Department of Agriculture. By means of these values, a comparison may be made between what was actually found in any feed here reported and the average composition of that feed. Of course, it could not be expected that every sample of feed would equal or go above the average composition of feed of that class, for the fact that there is an average, means that there are some samples which go below as well as some that go above that average.

In only four of the samples examined did the manufacturers guarantee the percentages of the valuable constituents. These are given in the table. This guarantee should be given in every case, as is done with fertilizers.

Hereafter the Board of Agriculture, according to its ruling, as given on page 20, will require all commercial stock feeds to be sold under a guarantee stating the minimum percentages of protein and fat they contain. This is an eminently proper requirement, as the purchaser should know what he is getting, and not have to buy blindly. Just as fertilizers have to be sold under a guarantee as to the percentages of phosphoric acid, ammonia and potash they contain, so stock feeds should be sold under a guarantee as to the percentages of protein and fat they contain, for is it not just as important to have good food for stock as for crops?

EXPLANATION OF THE TABLE.

In the table is given the percentages of water, ash, protein and fat, with the selling price per ton, and the constituents, as shown by the microscopic examination.

Water.—However dry a feed may appear, it always contains a considerable and variable quantity of water, which cannot be seen or felt, but which can be driven out by heat. This water is of no consequence unless present in an unduly large amount.

Ash.—The ash is what is left after the combustible part of a feed has been burned away. When a large amount of ash is present, it shows that some mineral matter has been added as an adulterant.

Protein.—The term protein is a general one, and is used to include all those nitrogenous materials which, when separated, bear a general resemblance in composition and properties to egg-albumin (white of egg), flesh-fibrin (lean meat), and milk-casein (curd). This portion of the food is essential to the formation in the animal of albumin, fibrin and casein; in other words, lean meat or muscle, bone, blood and milk. This is the most costly and by far the most valuable portion of stock feeds, and they should be bought chiefly for the protein which they contain.

Fat.—All feeds contain more or less fat or oil, such as corn oil, cotton seed oil, etc., which is used by the animal to produce energy and heat, or is stored up in the animal body as fat.

If the percentage of water, ash, protein and fat are added up and subtracted from one hundred, the remainder will consist of fibre and nitrogen-free extract. The fibre is the essential constituent of the walls of vegetable cells, and is the most insoluble portion of the vegetable substance and of quite subordinate value in food. The nitrogen-free extract, sometimes called carbohydrates, includes starch, sugar, gum and pectin. The use of these substances in the animal body is similar to that of fat; they serve to furnish energy, heat and, after proper elaboration, fat. Fat, however, furnishes over twice as much heat and energy as the nitrogen-free extract.

Price per ton is the price asked by the merchant from whom the sample was drawn, and is given so that after comparison with the percentages of protein and fat it can be seen which is the cheapest food.

Miscroscopical examination shows of what material or materials the feed is composed.

In studying the table it is seen that most of the samples are low in water, and that the amount of ash is about right, showing that no mineral matter has been added. Two samples of bran, Nos. 2 and 4, fall somewhat low in protein, and only one lower in fat than the average. They were all wheat bran, without any added impurities.

The samples of cotton seed meal were all of good quality, although all were lower in fat than the average as given. This is due to the fact that the average was made some years ago, and since that time improved methods of extraction remove more of the oil than formerly.

The cotton seed feed is composed of hulls, with some adhering lint, and besides being a low grade material, is largely indigestible by stock.

The oat feeds contain an excess of oat hulls, and all fall below what they are guaranteed to contain.

The samples of middlings, shorts, gluten feed and flax seed meal, all come up to standard, and are of good quality. The shorts contain some cockle.

The other feeds, such as chop, mill feed and shipstuff, are of indefinite composition, so that the analysis does not show whether they are what they should be or not. This brings out the necessity of having all feeds guaranteed as to their contents. Of the four feeds which have a guarantee, three fall below in protein and two in fat, thus again emphasizing the necessity of having all feeds sold under a guarantee.

AVERAGE COMPOSITION OF PURE FEEDS NAMED.

Laboratory No.	Name of Article.	Name and Address of Manufacturer or Wholesaler.	From Whom and Where Collected.	Water—Per Cent.	Ash—Per Cent.	Protein—Per Cent.	Fat—Per Cent.	Price per Ton.	Contents as Shown by Microscope.
. .	Bran, Wheat			11.9	5.8	15.4	4.0		
. .	Midlings			12.1	3.3	15.6	4.0		
. .	Shorts			11.8	4.6	14.9	4.5		
. .	Corn			11.0	1.5	10.4	5.0		
. .	Corn Meal			15.0	1.4	9.2	3.8		
. .	Corn and Cob Meal			15.1	1.5	8.5	3.5		
. .	Oats			11.0	3.0	11.8	5.0		
. .	Cotton Seed Meal			8.2	7.2	42.3	13.1		
. .	Gluten Feed			7.8	1.1	24.0	10.6		
. .	Linseed Meal			10.1	5.8	33.2	3.0		

RESULTS OF THE EXAMINATION OF COMMERCIAL FEED-STUFFS.

1	Bran, Wheat	Ballard & Ballard, Louisville, Ky	N. R. Savage & Son, Richmond, Va	8.52	6.77	16.00	3.69	$23.00	Wheat Bran.
2	" "	Gamble & Davis, Roanoke, Va	Farmers' Supply Co., Roanoke, Va	9.87	6.55	13.79	4.61	25.00	" "
3	" "	S. C. Hurt & Sons, Lynchburg, Va	S. A. Martin & Co., Lynchburg, Va	9.58	6.84	15.13	6.32	22.00	" "
4	" "	Myer & Brulle, Fredericksburg, Va	J. McCalla Boulware & Son, Fred'ksburg, Va	9.22	5.89	13.25	4.35	21.00	" "
5	Bran Ben Hur	Royal Milling Co., Minneapolis, Minn	S. Hirsh & Bros., Fredericksburg, Va	8.60	6.68	16.31	6.32	21.00	" "
6	Bran Wheat	Allen Smith, Knoxville, Tenn	Jesse Jones & Son, Norfolk, Va	8.92	6.32	16.31	5.73	20.00	" "
7	Cotton Seed Meal		Woodey Evans Co., Lynchburg, Va	7.10	6.39	42.00	10.40	17.00	Cotton Seed Meal.
8	" " "	N. C. Cotton Oil Co. Charlotte, N. C	Turner & Co., Charlottesville, Va	6.59	6.00	44.75	10.57	28.00	" " "
10	" " "	Newburn Cotton Oil Co., Newburn, N. C	N. R. Savage & Son, Richmond, Va	6.38	6.93	45.31	9.61	27.00	" " "
11	" " "	N. R. Savage & Son, Richmond, Va	T. J. Wills & Co., Charlottesville, Va	7.36	7.15	48.12	9.92	30.00	" " "
9	" " Feed	Southern Cotton Oil Co., Charlotte, N. C	Woodey Evans Co., Lynchburg, Va.	9.06	2.64	8.81	3.15	17.00	Cotton seed hulls & lint.

12	Chop, Victor	The American Cereal Co., Chicago, Ill	N. R. Savage & Son, Richmond, Va., found	7.35	8.71	8.16	3.64	23.00	Corn Chop.
			Guaranteed	....	....	9.00	4.00	....	
13	Chop	Ballard & Ballard, Louisville, Ky.	Wertz & Moorman, Roanoke, Va.	10.12	3.68	17.56	4.90	23.00	Midlings, bran and a little corn.
14	" Dandy	Commercial Milling Co., Detroit, Mich.	J. Mc'alla Boulware & Son, Fred'icksburg, Va	9.32	3.97	8.88	4.19	23.00	Corn chop.
16	" Mill	Gamble & Davis, Roanoke, Va	Farmer's Supply Co., Roanoke, Va.	10.55	4.48	9.75	3.17	25.00	Corn and bran.
17	" Premium	Imperial Grain & Mills Co., Toledo, O.	City Hay & Grain Co., Norfolk, Va	7.87	3.99	6.31	2.47	21 00	Corn chop with very little oats.
21	Corn Feed Meal	Great Western Cereal Co., Chicago, Ill	Dickey & Alrich, Fredericksburg, Va.	10.53	2.31	9.94	6.04	25.00	Corn.
15	Boss Corn and Oat Chop	Great Western Cereal Co., Chicago, Ill	N. R. Savage & Son, Richmond, Va., found	8.23	3.99	9.20	4.83	22.00	Corn with little oats.
			Guaranteed	....	....	9.00	4.00	....	
18	Best Corn and Oat Chop	....	N. R. Savage & Son, Richmond, Va	8.58	4.97	6.81	2.42	21.00	Corn chop with small amount of oats.
19	Victor Corn and Oats Feed	The American Cereal Co., Chicago, Ill	J. B. Andrews, Charlottesville, Va., found	8.65	4.75	8.44	4.08	20.00	Corn chop with small amount of oats.
			Guaranteed	....	....	9.00	4.00	....	
20	Vim Oat Feed	The American Cereal Co., Chicago, Ill	J. B. Andrews, Charlottesville, Va. found	6.84	5.95	6.38	2.38	14.00	Oats and oat hulls.
			Guaranteed	....	....	7.50	2.75	....	
34	Royal Oat Feed	The Great Western Cereal Co., Chicago, Ill.	Wertz & Moorman, Roanoke, Va., found	8.43	5.48	6.50	2.56	15.00	Oats and oat hulls.
			Guaranteed	....	....	7.80	2.80	....	
22	Mill Feed	Richmond Flour & Feed Co., Richmond, Va	City Hay & Grain Co., Norfolk, Va.	9.65	5.71	11.00	3.41	22.00	Bran, midlings corn and oats.
23	Mixed Feed	Wertz & Moorman, Roanoke, Va	Wertz & Moorman, Roanoke, Va.	10.24	4.41	10.17	2.80	23.00	Corn with bran and oats.
24	Shipstuff	Ballard & Ballard, Louisville, Ky	J. Mc'alla Boulware & Son, Fred'icksburg, Va	9.97	5.38	17.31	4.71	23.50	Bran.
25	"	Fairbanks & Co., Richmond, Va	Kerse Grocery Co. Richmond, Va	9.40	5.01	15.69	4.94	30.00	Bran and midlings.
26	"	S. C. Hurt & Sons, Lynchburg, Va	S. A. Martin & Co., Lynchburg, Va	10.39	2.73	12.50	3.13	25.00	Bran, midlings and corn.
27	" Dunlap's	Warner Moore & Co. Richmond, Va	N. R. Savage & Son, Richmond, Va	9.19	3.63	14.50	9.37	25.00	Bran, midlings and a little corn.
28	" Allen Smith's	Allen Smith, Knoxville, Tenn	City Hay & Grain Co., Norfolk, Va	10.04	4.99	13.19	4.19	24.00	Bran, midlings and a little corn.
29	No. 2	Allen Smith, Knoxville, Tenn.	S. A. Martin & Co., Lynchburg, Va	9.67	4.17	14.54	5.89	24.00	Bran, midlings and a little corn.
30	Midlings	Pillsbury Mills, Minneapolis, Minn.	Farmer's Supply Co. Roanoke, Va	10.99	2.70	17.88	5.10	30.00	Midlings.
31	Shorts	White Star Mills. Staunton, Va	Elliott Bros., Charlottesville, Va	9.89	5.36	15.62	4.71	22.00	Bran, shorts and a little cockle.
32	Gluten Feed	Glucose Sugar Refining Co. Chicago, Ill	T. J. Wills & Co., Charlottesville, Va	8.75	2.59	25.31	3.44	30.00	Gluten feed.
33	Flax Seed Meal	N. R. Savage & Son, Richmond, Va	J. T. Wills & Co., Charlottesville, Va	9.28	4.85	33.30	2.54	30.00	Flax seed meal.

FLOUR.

By E. W. Magruder.

Flour in this country is the internal portion of wheat separated from the bran and reduced to a finely divided state. The highest priced flour is not always the most nutritious, as the whiter ones are usually the most expensive, while the darker ones are likely to contain the most protein.

Flour is not much adulterated in this country. Starch and corn meal are sometimes added, and in Europe mineral matter is not uncommonly put in, but it has not been found in flour in this country. Alum is also sometimes found in flour, being put in to whiten an inferior quality. The results of the examination of 23 samples of flour are given in the following table. None of them were found adulterated:

RESULTS OF THE EXAMINATION OF FLOUR.

Laboratory No.	Name of Brand.	Name and Address of Manufacturer.	From Whom and Where Collected.	Price per Barrel.	Results of the Chemical and Microscopical Examination.
35	Marguerite	Allen & Whitter, Troy, O	Wertz & Moorman, Roanoke, Va	$4 75	Pure wheat flour.
36	Porcelain Patent	Anderson Bolling, Staunton, Va	J. D. Watson, Charlottesville, Va	5 40	" "
37	Ballard & Ballard's	Ballard & Ballard, Louisville, Ky	Kerse Grocery Co., Richmond, Va	4 50	" "
38	Belmont XXXX	Bridgewater Mill, Fredericksburg, Va	S. Hirsh & Bros., Fredericksburg, Va	4 40	" "
39	H. G. 6 X	Fredericksburg Milling Co., Fredericksburg, Va.	" " "	4 25	" "
40	White Rock Extra	S. C. Hurt & Son, Lynchburg, Va	D. C. Sandidge & Co., Lynchburg, Va	4 50	" "
41	Daisy Patent	Houstind Milling Co., Alliance, O	Hough & Herbert Co., Norfolk, Va	5 00	" "
42	Idol	Lexington Roller Mills, Lexington, Ky	D. C. Sandidge & Co., Lynchburg, Va	4 50	" "
43	Cream	" " "	" " "	5 00	" "
44	Red Cross	J. C. Lewis, Malvsrn, O	Hough & Herbert., Norfolk, Va	4 80	" "
45	J. W. Mason's Best	J. M. Mason, Roanoke, Va	J. M. Harris & Co., Roanoke, Va	4 75	" "
46	XXXXX Brand	Myer & Brull, Fredericksburg, Va	S. Hirsh & Bros., Fredericksburg, Va	4 40	" "
47	Jewell	Pffefer Milling Co., Lebanon, Ill	J. M. Harris & Co., Roanoke, Va	4 60	" "
48	Ben Hur	Royal Milling Co., Minneapolis, Minn.	S. Hirsh & Bros., Fredericksburg, Va	4 75	" "
49	Royal	" " Lexington, Ky	" " "	4 25	" "
50	Royal Patent	Voight Milling Co., Grand Rapids, Mich	Hough & Herbert, Norfolk, Va	5 25	" "
51	Defender	Washington Milling Co., Washington, O	E. Turner & Co., Charlottesville, Va	4 50	" "
52	Monitor	" " "	Woodey Evans Co., Lynchburg, Va	5 00	" "
53	Climax	Washbourn, Crosbey & Co., Louisville, Ky	" " "	4 25	" "
54	Best Patent	E. S. Woodard, Norfolk, Va	C. F. Brown, Norfolk, Va	4 75	" "
55	Lilly	" " "	" " "	4 25	" "
56	Melrose	White Star Mills, Staunton, Va	T. J. Wills & Co., Charlottesville, Va	5 25	" "
57	White Star	" " "	E. Turner & Co.,	4 75	" "

CORN MEAL.

By E. W. Magruder.

Corn meal is not often found adulterated, though sometimes mineral matter is added.

The following table gives the result of the examination of twelve samples of meal, none of which were adulterated.

RESULTS OF THE EXAMINATION OF MEAL.

Laboratory No.	Name of Brand.	Name and Address of Manufacturer,	From Whom and Where Collected.	Price per Bushel.	Results of the Chemical and Microscopical Examination.
58		Bridgewater Mills, Fredericksburg, Va	Simon Hirsh & Bros., Fredericksburg, Va.	70 cts.	Pure Corn Meal.
59		Brown & Graves, Charlottesville, Va	J. D. Watson, Charlottesville, Va	75 "	" " "
60	Daisy	The Daisy Mills, Norfolk, Va	C. F. Brown, Norfolk, Va	75 "	" " "
61	Dunlop Mills Meal	Dunlop Mills, Richmond, Va	N. R. Savage & Son, Richmond, Va	80 "	" " "
62	Fairbanks	Fairbanks & Co., Richmond, Va	Kerse Grocery Co., Richmond, Va	80 "	" " "
63		Gamble & Davis, Roanoke, Va	Wert & Moorman, Roanoke, Va	65 "	" " "
64		E. D. Haden, Charlottesville, Va	E. Turner & Co., Charlottesville, Va	60 "	" " "
65		H. H. Hartman, Charlottesville, Va	T. J. Wills & Co., Charlottesville, Va	70 "	" " "
66	Hurt's	S. C. Hurt & Son, Lynchburg, Va	S. A. Martin & Co., Lynchburg, Va	62 "	" " "
67		J. B. Garst, Roanoke, Va	J. M. Harris & Co., Roanoke, Va	65 "	" " "
68		Nordmyer & Berding, Covington, Ky	Hough & Herbert, Norfolk, Va	75 "	" " "
69		Pierce, Akers & Co., Lynchburg, Va	Woodey Evans Co., Lynchburg, Va	65 "	" " "

The Land Title Question in Virginia.

There is a "Land Title Question" in Virginia not dependent upon climate and apart from the character of the soil—a question of practical moment to every owner of land. In two words, it is a question of TITLE and of TRANSFER OF TITLE.

We print below a brief exposition of the Torrens System of Land Registration, which is claimed by its advocates to be an improvement on our present system. If it will accomplish what its friends assert, it will be of vast benefit to the farmers. At all events it is a question in which the farmers are deeply concerned, and in order that they may know what is being proposed in the Legislature we publish the following exposition of the subject:

THE TORRENS SYSTEM OF LAND REGISTRATION.

BY EUGENE C. MASSIE.

The State claims to be the owner—the original and ultimate owner—of all her lands. This ownership first appears in her *land grants*, and is now found in the exercise of the right of *eminent domain*, of *escheats* and in the levying of *taxes*.

Claiming and exercising these original rights and sovereign powers, it is the duty of the State to grant good titles to her citizens and to enable them to keep their titles good under the just administration of equitable land laws.

This plain duty has never heretofore been performed by the State, and the time has now come when she must meet her high obligation.

In 1900 there were 103,806 male citizens of the Commonwealth assessed for taxes on real estate valued, in each instance, at not less than $300.00. These citizens represent the thrift and intelligence of the Commonwealth, and their rights must be respected by our law makers.

The real estate of Virginia is assessed at 343 3-4 millions, or nearly three times as much as all the personal property returned for taxation in the State.

You can sell your personal property or borrow money on it quickly and at little expense. You do not have to employ a lawyer to examine the title to your horse or cow, to your oats and hay, nor to your stocks and bonds.

If you try to sell your land or borrow money on it, the first question is;

HAVE YOU GOT A GOOD TITLE?

No one will buy nor lend you money without being satisfied about your title. *It must be examined by a lawyer, and you have to pay the bill.*

It does not matter how often the title has been examined before, it has to be re-examined every time a new deal is made.

The same old titles are examined over and over again, and every time you have to pay the bill.

A conservative estimate, based upon the returns from the county clerks

throughout the State, shows that the people of Virginia paid more than $420,000.00 for abstracts of titles to lands in 1904.

This is nearly as much as was spent upon all the public schools in the 100 counties of our State, and more than half of what was spent for public education in every city and county of the Commonwealth.

This heavy and perpetual tax on the people will be saved by the Torrens System of Land Registration.

It is not only expensive, but it takes days and weeks to make an examination of title, and so many difficulties are encountered that business men frequently have not the time to bother with transactions involving so many problems.

All this makes land hard and slow to handle, and men hesitate to bury capital in lands.

The Torrens System will make your lands merchantable. It will convert lands into a quick asset and render them available as a source of ready commercial credit.

It operates in the following manner:

1. *A title is examined* ONCE *officially,* and confirmed by order of court. That ends the matter, and cuts out the endless examinations of titles now necessary. *Your title is registered,* and you have made a *permanent improvement,* which will last as long as the law prevails, and will never call for betterments or repairs.

2. *You are then given* a *certificate* of *title,* which guarantees to all the world that you have such title as is set forth therein to the lands therein described—for example, a life estate, or a fee simple, in whole or in part, free from encumbrances or subject to such encumbrances as are mentioned in the certificate.

3. *You can deal* with this certificate of title almost as freely as with a certificate of stock, because everybody can see from the certificate exactly what your title is.

This will put your real estate on a footing with your personalty, and will add millions to the business capital of Virginia.

The Torrens Act will *help the farmers* and everybody who owns real estate in the country, as well as in the city.

It will kill the business of the land grabber in Virginia.

It will enable the State to collect her taxes promptly, and no man's land, when registered, can be sold for delinquent taxes without his knowledge.

It will help everybody who deals in real estate.

It will lessen the cost of transactions in real estate, stimulate and enlarge the market, and thus increase values; and when a poor man buys a home he will get a good title to it and no one can take it away from him.

It will promote development of the whole State by settling titles. And it will invite immigration, because strangers will not hesitate to buy such guaranteed titles.

The Torrens System is No Experiment.

It has been tested in South Australia since 1858, and soon spread to Queensland, Victoria, New South Wales, and West Australia. It has long been in operation in Tasmania, New Zealand, Vancouver, and British Columbia; also

in Manitoba, Ontario, and the Northwest Territory of Canada, comprising the four provinces of Athabasca, Alberta, Assineboia, and Saskatchewan. Even conservative England has been testing it since 1862, and in 1900 Parliament appropriated $1,325,000.00 for a Land Registry Office in Lincoln's-Inn-Fields. Registration of possessory titles has been compulsory in London since May 1, 1901. Nova Scotia has recently adopted the system; and a similar system of title registration has been in operation in Prussia since 1872. It has been proven to be suited to old as well as new countries, to monarchial as well as democratic institutions, to large and complicated holdings, to extensive estates and wild lands, as well as to small tracts and city lots.

The Torrens System has found congenial soil in the United States in Illinois, California, Massachusetts, Minnesota, Oregon, and Colorado; and the Federal Government has established it in Hawaii and the Philippine Islands. In addition to this, Arkansas, the District of Columbia, Georgia, Iowa, Kentucky, Louisiana, Maine, Michigan, Mississippi, Missouri, Montana, Nebraska, New York, North Dakota, Pennsylvania, Porto Rico, Rhode Island, Tennessee, Texas, Utah, Washington, West Virginia, and Wisconsin have taken steps more or less pronounced for its adoption. The question is:

Shall Virginia keep up with the procession, or, halting, lag behind?

If Virginia wishes to preserve an honorable place in the march of progress, *she must do justice to her land owners.* The spirit of our land laws is the spirit of mediaeval oppression and restriction. We are living under a superannuated system, originated by Norman lawyers under William the Conqueror, and venerable only as a relic of an antique age. Feudal methods are not suited to this age. Laws made when lands were held under royal grants and sold for ten cents an acre are not suited to the business methods and commercial requirements of this day and generation.

It is entirely voluntary, not compulsory. It simply gives you an opportunity to register your lands if you should see fit to do so.

It imposes no liability on the Commonwealth.

It will more than pay for itself.

There is no valid reason why any one should object.

Section 100 *of our new Constitution especially authorizes the Legislature to adopt the Torrens System in Virginia.*

It has been approved by the Virginia State Bar Association, the Bar Association of the City of Richmond, the Virginia Bankers' Association, the Virginia Board of Trade, the Virginia Real Estate Association, and the Chamber of Commerce of the City of Richmond.

It is supported by the *Times-Dispatch*, the *News-Leader*, and the *Evening Journal*, of Richmond; the *Landmark* and the *Virginian-Pilot*, of Norfolk; the *Petersburg Index-Appeal*, the *Fredericksburg Star*, the *Charlottesville Daily Progress*, the *Staunton Daily News*, the *Harrisburg Spirit of the Valley*, the *Virginia Law Register*, and other influential papers throughout the State.

The Use of Lime in the Soil.

ON SOUR SOILS OR STIFF CLAYS IT IS OF GREAT VALUE—SOME NOTABLE TESTS AT THE OHIO EXPERIMENT STATION—DANGER OF USING LIME TOO CONSTANTLY.

Several readers have lately asked for an article on liming land, and it happens that just at this time the Ohio Experiment Station has made public the results of a long and carefully-planned series of tests of this matter. Dr. Henry Wallace, editor of *Wallace's Farmer*, one of the ablest agricultural authorities in America, reviews the subject in the following letter:

The Ohio Agricultural Experiment Station is doing some very fine work in determining by actual experiments the uses of lime as a fertilizer on the farm.

The application of lime as a fertilizer is of very ancient date. It seems to be adopted by farmers all the world over when certain conditions occur in the management of their farms. In our boyhood the application of lime to the soil was a sort of certificate of agricultural character. The man who burned a kiln of lime and applied it on a piece of his land every year had a very high standing in the community. The man who failed to do so was regarded as lacking some of the qualifications of the good farmer. This practice was continued for quite a number of years and then abandoned. So far as we know, until very recently there has been in the United States no thorough scientific investigation of the mode of action of lime in the soil. Farmers in Pennsylvania and all the Eastern States applied it because it brought the answer. Just why they did not know.

LIME NOT A FERTILIZER, BUT CORRECTS ACIDITY.

The investigation of the Ohio Station explain a number of things that were apparently contradictory. In our boyhood days we applied lime to the soil that had the most lime in it and apparently the least need of it. There it did best. On soils apparently deficient in lime, had little effect; neither had it much effect unless applied in connection with vegetable matter.

While lime is absolutely indispensable to the growth of all plants, yet there is such a superabundance of it in almost all soils that it is utterly without value as a direct source of fertility. What, then, is its use? First, to neutralize acidity. If we take up the history of the application of lime in all countries, we find it comes in after the soil has been somewhat worn, say thirty, forty, or fifty years after it has been brought into cultivation. These soils are acid, and hence it pays to use lime in sufficient quantities to correct the acidity. In fact, leguminous crops never do well on an acid soil. The bacteria which characterize these crops seem to require a soil that is slightly alkaline.

CHEMICAL USES OF LIME IN THE SOIL.

There is another reason. Warrington, an English investigator, and others, have shown that the process of nitrification is dependent on the presence in the soil of a base with which the nitric acid resulting from the nitrifying processes (that is, the conversion of nitrogen into nitrates, whether from manure or clover roots) may unite and form what is known as a salt. For this purpose lime is the most suitable material. These same investigators have shown that an excessive application of quicklime may have an exactly contrary effect.

Another function of lime is the liberation of plant food from compounds in the soil. If the farmer will put a little quick lime on fresh stable manure he will soon smell the ammonia. This means that the lime is entering into chemical union with certain constituents of the manure, and in doing this is liberating others, which pass off in the form of ammonia. This explains why lime applied in connection with manure, but not in contact with it, produces such a wonderful growth of vegetation. In our boyhood we were taught that lime must not be mixed with manure or it would "eat it up"; but that if the manure or clover was turned under, the ground thoroughly cultivated, and the lime applied as a surface dressing at the time the crop was sown (always wheat), then the lime would fix the ammonia resulting from the decomposition of the manure and render it available for the plant food. This was the doctrine taught us in our boyhood, and it is confirmed by the investigations of the Ohio Station.

EFFECT OF LIME ON SOIL TEXTURE.

There is a third use of lime, and we think this may prove the most important of all; namely, changing the texture of physical condition of the soil. It was found on our home farm that a very heavy clay soil became quite friable and easily worked after it had been treated to an application of lime. It was also found that a sandy point in the same field, which would produce nothing beforehand, became entirely changed in its texture and produced without seeding an abundant crop of white clover. We don't know that we can state this point any more clearly than the Station does in its Bulletin No. 159, as follows:

"When heavy, plastic clay is wet, pressed into a cake and then dried it becomes almost brick-like in texture; but if a small portion of quick lime be incorporated with the clay before manipulation, it will crumble easily between the fingers after drying. For this purpose lime may be usefully employed on many of the more refractory clay soils, using it at the rate of several tons per acre. Clays thus treated will become much more friable, will respond more readily to cultivation and manuring and will not pack so readily under rain. The effect of such an application of lime will last for a number of years. It will be easily understood that the opening of the soil by a dressing of lime will facilitate the action of air, rain, and other agencies

by which the plant food of the soil is made available to crops. Loose, sandy soils may also be improved by liming, the lime rendering them more compact and more retentive of moisture.

WHEN LIME IS HARMFUL.

"For more than a century British and European farmers have used lime on the soil, and the effect of lime has been summarized in the proverbs:

"'Lime enriches the father, but impoverishes the son.'

"'Lime and lime without manure
Will make both farm and farmer poor.'

"This does not mean that lime should never be used, nor that lime should be mixed with manure; but that lime and manure should follow each other in an intelligently ordered succession."

Not all of our readers will be interested in this, nor, in fact, are they all in any other article; but we commend the conclusions of the Ohio Station to our readers who have acid soils, and also to those of our readers who have stiff, tenacious clay or gumbo soils, and suggest that an application of quick lime to a gumbo soil may change its character altogether.—*Progressive Farmer.*

How to Lay a Cement Floor in Cellar.

Have you got a cement floor in your cellar? It is much nicer than an earthen floor. No dirt need be tracked upstairs from a cement floor. It can be swept the same as you would a board floor. And the cost need be but little. It is a small matter, but one that helps to make the home more comfortable. If you have $5, more or less, to spare, and a little time, and can haul the sand, you can make this improvement yourselves. If your cellar is damp, or wet on the botom, think how much nicer it will be than walking around on boards. A barrel of common cement will be enough for 100 square feet of floor. It can be bought for $1 here, at retail. It will take about two-thirds of a cubic yard of sand, or fine gravel, for 100 square feet. It will not matter if the sand is not entirely free from soil, or clay. Ordinary bank sand, or gravel will do. A little clay or loam will do no harm. In fact, experiments carried on at our State University seem to show that clay added to the sand up to 15 per cent. actually increased the strength of the mortar for such work as this, but not for mortar to be under water. When we were putting in our furnace years ago we lowered the floor of room it was put in so

as to make it about 9 feet in the clear. In digging down we got some sandy gravel with certainly 15 or 20 per cent. of loam in it. It was right there and handy to use for new floor; so I asked a man who had had much experience, if it would answer and he shook his head and said we had better get clean sand. But we used it, and the floor is now hard enough for any one. So I am not surprised at the results of the University tests. You do not need clean, washed sand for a cellar floor. But I have not dared to tell you so before. Get fresh cement that has not been kept in a damp place and thus become partially set and caked. Mix thoroughly while dry, over and over, until it is all one color, one pail of cement with three pails of sand. Then moisten and mix thoroughly again. You can do this mixing in a large box in the cellar. Make mortar just thin enough so you can spread it nicely with a trowel. Hoe, garden rake and shovel are good tools to mix with dry, and the hoe when wet. Lay a 2x4 scantling across one end of cellar about 2 feet from wall. Fill in with mortar and level off with top of 2x4; then move the 2x4 about 2 feet and lay another strip of mortar, and so on. A board straight-edge will be handy to level off surface with. You will soon learn to get mortar about right thickness to work well. Be sure it is pressed down enough at the joints to unite well. Two inches is thick enough for any cellar floor where the ground is ordinarily dry and drained. If water is likely to rise in the bottom at times, that is, the earth is springy, then make floor thicker, and mix in coarse gravel, or broken stone, sufficient to make weight enough to stand the upward pressure of water, putting a thin finishing coat on top before the foundation coat is dry. And cement mortar properly put on the sides will prevent water from coming in through the walls. I know, for we have tried it. If water sometimes comes through west wall, or any other, during a driving rain, cement it, at the same time you do the bottom. You can keep it out as you can keep it in, or out of a cistern. The cement floor will set so you can walk on it, with care, in a day or so. It will be some months getting entirely hard. During that time be careful to not do anything to mar it. I would make the surface quite smooth so you can sweep it easily. Do not let frost get in the cellar while the mortar is green, and it is better that the floor dry slowly. The earthen floor should be graded off quite level before beginning to lay mortar. Then you can make the finished surface quite level. No rat or mouse can get into our cellar, except through an open door. There are screens for all windows. If you can get the sand you can lay the floor while you have plenty of time this winter, as well as any time. Sandy gravel will do if more handy to get than sand.—*T. B. Terry.*

A Word to Our Farmers.

The annual report will be sent free to any farmer who will kindly send me his name and post office. The report for each year should be filed for future reference as back numbers cannot be supplied. The spray calendar printed

in the report for 1904 will be particularly valuable for future reference. All names received are put on the permanent mailing list. I am always very glad to hear from my fellow-farmers and have suggestions from them. It is my endeavor to make the annual reports useful and helpful along practical lines on the farm.

I desire to express my appreciation of the great many kind letters received in the past few years. I appreciate every one of them. Always write me whenever I can serve you. Letters are frequently received with no post-office address, and sometimes the writer neglects to sign his name to the letter. Samples of mineral are also sent without the sender's address. All of these I am unable to answer.

Very truly yours,

G. W. KOINER.
Commissioner.

BULLETIN No. 4.

STATE TEST FARM,

Located at Saxe, Charlotte Co., Va.

UNDER THE CONTROL OF THE

State Board of Agriculture.

PROF. S. B. HEIGES, Manager.

STATE BOARD OF AGRICULTURE.

Sirs,—I have the honor to report upon the experiments conducted and upon the general farm work of the Virginia Test Farm from January, 1905, till December, 1905.

Yours truly,

S. B. HEIGES, Manager.

SAXE P. O., December 4, 1905.

SYNOPSIS OF WEATHER BUREAU REPORT.

STATION, STATE TEST FARM, SAXE, VA.

1905.	No. of Rainy Days.	Rainfall in inches.	Highest Temperature.	Lowest Temperature.	Remarks.
January	8	2.48	70°F.	0°F.	Seven killing frosts and snow on 4th, total 2¾ inches.
February	12	3.52	54	5	Two killing frosts and 5 snows, total 1½ inches.
March	8	2.56	78	19	Five killing frosts.
April	11	3.79	86	26	Snow on 16th.
May	15	5.13	90	40	Five thunder storms.
June	7	2.00	97	47	One thunder storm.
July	17	7.42	96	57	Four thunder storms.
August	15	5.14	94	45	One thunder storm.
September	10	3.24	91	40	Normal conditions.
October	7	2.26	89	26	Three killing frosts.
November	4	0.44	79	10	Eleven killing frosts.
December	13	5.53	64	12	Frosts seven nights. Snow 1-4 in. Dec. 30.

Experimental Work.

STATE BOARD OF AGRICULTURE OF VIRGINIA:

The Executive Committee, at a meeting of the Board of Agriculture held in Richmond, December 13, 1904, passed a resolution requesting the manager of the State Test Farm to submit to their consideration a general plan of the test and experimental work to be conducted under the supervision of the Farm Committee.

In accordance therewith a report following the general line of work conducted by the experiment stations and test farms of other States was submitted to the Board at a special meeting held in Richmond, January 11, 1905.

The plan of work as set forth in BULLETIN No. 3, from page 4 to page 8, has been carried on as far as possible upon the following subjects of investigation, to-wit: Plat Experiments, Field Experiments, Tobacco Experiments, Forage Crops, Soil Improvement, Trenching and Draining, Orcharding, Grapes and Small Fruits, Forestry, Root Crops, Garden Vegetables, Breeding Corn, Animal Industries, Experiments with Cattle and Poultry.

As voluntary observer of the United States Weather Bureau of the Department of Agriculture, a daily record of the climatic conditions existing at the Test Farm and surrounding neighborhood has been taken by me and reported monthly to the proper authorities.

A comparison of the report from December, 1903, to December, 1904, inclusive, with that contained in the present report, extending from January, 1905, to December, 1905, should be a matter of interest to those investigating the influence of weather upon crops.

Whilst January, February and March, of 1904, had but twenty-two rainy days, with a total precipitation of 8.05 inches, the corresponding months of 1905 had twenty-eight days, with a total precipitation of 9.06 inches.

This comparatively insignificant difference, however, rendered the soil too wet and heavy to do any plowing for the spring crops. April 1st we found the land sufficiently dry to plow, but successive rains prevented similar work until April 25th, our lowlands being too wet earlier in the season.

April and May of 1904, having but eleven rainy days, with 4.43-inches rainfall, whilst the corresponding months of 1905 had twenty-six days, with an aggregate rainfall of 8.92 inches. This excessive precipitation materially affected both corn and wheat crops, delaying the planting of our corn, we finishing that work June the 15th.

The frequent and excessive rains, with a snow on the 16th of April oc-

curring at a most critical period in the growth of wheat, decreased our crop about one-third—our most promising wheat, estimated by expert judges to yield thirty bushels per acre, yielding no more than twenty bushels. June was remarkably dry, there being but seven rainy days, with a precipitation of but 2.00 inches, the one redeeming feature of the month being the unusually fine weather for hay-making and harvesting.

July and August aggregated thirty-two days of rain, with a total precipitation of 12.56 inches. With upwards of 50 per cent. rainy days, the working of the corn crop became a serious problem; in fact, we were obliged to omit the final working of one upland field, thereby preventing its seeding to crimson clover.

The excessive rains of July caused great inconvenience in securing our wheat crop, being obliged to turn the sheaves twice, opening them one clear day, to be rained upon the next. Notwithstanding every precaution that we could exercise, about eight dozen sheaves sprouted.

September and October were ideal months for preparing the land for seeding. Whilst the soil occasionally between rains became too dry, by more frequent use of the disc and roller the seed-bed was put into the finest condition of any year that the farm has been used for test and experimental purposes.

The continued dry weather of the latter half of October, however, has retarded the growth of wheat and winter oats, there having been sufficient moisture up to the 25th of the month to cause an unusual high percentage of germination. The corn has been thoroughly cured on stalk or in shock, and finer weather for cribbing it could not be desired.

The month of November has been unusually dry, there having been less than one-half inch of rain during the entire month. Wheat and winter oats have consequently suffered severely. During December the precipitation was 5.58 inches.

PLAT EXPERIMENTS.

We have already reported that, instead of continuing thirty-six plats in any one crop, we propose to divide series 1 and 2 of thirty-six plats each into subdivisions of eighteen plats each, continuing the same numbers in order that reference may more easily be made to the plan of fertilization adopted in 1901, and continued ever since without any alteration; that is, subdivision 1 shall run from 1 to 18 inclusive, and subdivision 2 shall run from 19 to 36 inclusive. The wheat plats having been seeded before this plan was submitted for the season of 1905, cover the entire thirty-six.

We have found that the fertility of the soil can neither be retained nor improved by the use of commercial fertilizers alone, and this subdivision of the plats provides for a four-year rotation, each plat in that length of time being one year in grass. A rotation like the following has been suggested: Corn followed by oats; oats by wheat; wheat being seeded to clover and grasses

either in the fall or spring, said clover and grasses to remain one year before being turned under.

We again introduce the plan of fertilization that has been in use all these years, as some who read this BULLETIN No. 4 may not have access to those that have appeared in former years.

As stated in every former BULLETIN the symbols adopted to represent the various fertilizers used are not the recognized symbols of chemistry, but are those used at all experimental stations, owing to the ease with which they may be used as legends to the several plats.

FERTILIZATION OF PLATS, 1-10 ACRE EACH.

P. Represents Phosphoric Acid .....4.8 lbs.
N. (Nitrogen) represents Ammonia .....1.2 lbs.
K. (Potash) represents Potash .....1.2 lbs.
L. Lime.
M. Farm manure.

Normal application, 400 lbs. per acre of fertilizer.
Containing Phosphoric Acid .....12 per cent., giving per acre 48 lbs.
Ammonia ..... 3 per cent., giving per acre 12 lbs.
Potash ..... 3 per cent., giving per acre 12 lbs.

Which, therefore, will give on a tenth of an acre:
Phosphoric Acid .....4.8 lbs. equal P.
Ammonia .....1.2 lbs. equal N.
Potash .....1.2 lbs. equal K.

P. equals:

30 lbs. 16 per cent. Acid Phosphate.
26 2-3 lbs. 16 per cent. Thomas Slag.
24 lbs. 20 per cent. Bone.
40 lbs. 12 per cent. Phosphate Rock.

N. equals:

7.06 lbs. 17 per cent. Dried Blood.
4.8 lbs. 25 per cent. Ammonium Sulphate.
6.3 lbs. 19 per cent. Sodium Nitrate.
30. lbs. 4 per cent. Bone.

K. equals:

2.4 lbs. 50 per cent. Sulphate of Potash.
2.4 lbs. 50 per cent Muriate of Potash.
10. lbs. 12 per cent. Kainit.

APPLICATION FOR EACH PLAT.

No. 1 of P., 30 lbs. Acid Phosphate.

No. 2 of P., 30 lbs. Dissolved Bone Black.

No. 3 of P., 26 2-3 lbs. Thomas Slag.

No. 4 of P., 40 lbs. Phosphate Rock.

No. 5 of N., 7.06 lbs. Dried Blood.

No. 6 of N., 4.8 lbs. Ammonium Sulphate

No. 7 of N., 6.3 lbs. Sodium Nitrate.

No. 8. of K., 2.4 lbs. Muriate Potash.

N. B.—Each one of these plats contained only one fertilizer—4 having P., 3 having N. and one having K.

No. 9, Blank.

No. 10 P. N., 30 lbs. Acid Phosphate and 7.06 lbs. Blood.

No. 11 P. N., 24 lbs. Bone.

No. 12 P. N., 24 lbs. Bone and 1.4 lbs. Blood.

No. 13 P. K,. 30 lbs. Acid Phosphate and 2.4 lbs. Muriate Potash.

No. 14 N. K., 7.06 lbs. Blood and 2.4 lbs. Muriate Potash.

Each one of these plats contained two fertilizers, 3 having P. and N., one having P. and K. and one having N. and K.

No. 15 P. N. K., 30 lbs. Acid Phosphate, 7.06 lbs. Blood and 2.4 lbs. Muriate of Potash.

No. 16 P. N. K., 30 lbs. Acid Phosphate, 5 lbs. Blood, 6.3 lbs. Sodium Nitrate and 2.4 lbs. Muriate Potash.

No. 17 P. N. K., 30 lbs. Acid Phosphate, 4.8 lbs. Ammonium Sulphate, 2.4 lbs. Muriate Potash.

No. 18 P. N. K., 26 2-3 lbs. Thomas Slag, 7.06 lbs. Blood, 2.4 lbs. Muriate Potash.

Nos. 19 P. N. K., 40 lbs. Phosphate Rock, 7.06 Blood, 2.4 lbs. Muriate Potash.

Each one of these plats contains three fertilizers, P. N. and K.

20, Blank.

21 P. 1-2 N. K., 15 lbs. Acid Phosphate, 7.06 lbs. Blood, 2.4 lbs. Muriate Potash.

22 P. N. 1-2 K., 30 lbs. Acid Phosphate, 3.5 lbs. Blood, 2.4 lbs. Muriate Potash.

23 P. N. K. 1-2, 30 lbs. Acid Phosphate, 7.06 lbs. Blood, 1.2 lbs. Muriate Potash.

These plats contain one-half the quantity of one fertilizer each. (A numeral or a fraction after a symbol affects only what is before it.)

No. 24, 200 lbs. Cayuga Plaster.

No. 25, P2. N. K., 60 lbs. Acid Phosphate, 7.06 lbs. Blood and 2.4 lbs. Muriate Potash.

No. 26, P2, N. K., 30 lbs. Acid Phosphate, 40 lbs. Phosphate Rock, 7.06 lbs. Blood, 2.4 lbs. Muriate Potash.

No. 27, P. N2, K., 30 lbs. Acid Phosphate, 14.12 lbs. Blood, 2.4 lbs. Muriate Potash.

No. 28, P. N.2, K., 30 lbs. Acid Phosphate, 7.06 lbs. Blood, 2.4 lbs. Sulphate of Potash. In March apply 6.3 lbs. Nitrate Soda.

N. 29, P. N. K2., 30 lbs. Acid Phosphate, 7.06 Blood, 4.8 Muriate Potash. Each of these plats had one fertilizer doubled.

No. 30, 2 (P. N. K.), 60 lbs. Acid Phosphate, 14.12 lbs. Blood, 4.8 lbs. Muriate Potash.

This plat had each fertilizer doubled. (A numeral before the parenthesis affects each symbol in it.)

No. 31, Blank.

No. 32, 1,600 lbs. Stable Manure.

No. 33, 3,200 lbs. Stable Manure.

No. 34, 400 lbs. Lime.

No. 35, P. N. K. L., 30 lbs. Acid Phosphate, 7.06 lbs. Blood, 2.4 lbs. Muriate Potash and 400 lbs. Lime.

No. 36, Blank.

EXPERIMENTAL WHEAT PLATS, 1-10 ACRE EACH.

As already referred to in report on weather conditions of the year, the months of October and November, 1904, were unusually dry and frosty, there being twenty-six nights of frost during these two months, ice forming on the 16th of October.

Whilst the wheat did not make a very vigorous growth during the fall, it appeared to be in a fine condition in the spring, very little having been drowned or frozen out. The plats were carefully examined during the spring and summer for the purpose of noting the presence of any disease and the difference of growth on each plat. As another year had passed without having a barn erected upon the farm, we were again obliged to *estimate* instead of weighing the yield of each plat.

We formerly threshed each plat separately with the flail, weighing the yield as cleaned. Being unable to do this, the bands were all cut the same length and the sheaves were made of uniform size.

The plats were all craddled, finding it impossible to operate the binder on these small plats and keep the wheat of each separate. Before cradling each plat was carefully examined as to size and fullness of head and plumpness of kernels.

With these factors and the number of sheaves of uniform size of each plat we made the following deductions as to the yield of each plat:

Plat No. 17 was superior to all others in length of straw, size and fullness of head. Assuming this yield to be 10, the several plats yielded as follows:

Plat No. 1, the yield was 4.
Plat No. 2, the yield was 4 1-2.
Plat No. 3, the yield was 6.
Plat No. 4, the yield was 5.
Plat No. 5, the yield was 4.
Plat No. 6, the yield was 2 1-2.
Plat No. 7, the yield was 2 1-2.
Plat No. 8, the yield was 3.

Plat No. 9, the yield was 2 1-2.
Plat No. 10, the yield was 7 1-2.
Plat No. 11, the yield was 6 1-2.
Plat No. 12, the yield was 7.
Plat No. 13, the yield was 6.
Plat No. 14, the yield was 6.
Plat No. 15, the yield was 9.
Plat No. 16, the yield was 9 1-2.
Plat No. 17, the yield was 10.
Plat No. 18, the yield was 7 1-2.
Plat No. 19, the yield was 7 1-2.
Plat No. 20, the yield was 2 1-2.
Plat No. 21, the yield was 6.
Plat No. 22, the yield was 6 1-2.
Plat No. 23, the yield was 6.
Plat No. 24, the yield was 3.
Plat No. 25, the yield was 7 1-2.
Plat No. 26, the yield was 6 1-2.
Plat No. 27, the yield was 6.
Plat No. 28, the yield was 5 1-2.
Plat No. 29, the yield was 8 1-2.
Plat No. 30, the yield was 5 1-2.
Plat No. 31, the yield was 2.
Plat No. 32, occupied by tobacco barn.
Plat No. 33, the yield was 7 1-2.
Plat No. 34, the yield was 6 1-2.
Plat No. 35, the yield was 8 1-2.
Plat No. 36, the yield was 2 1-2.

NOTE.—Plats Nos. 9, 20, 31 and 36 had no fertilizer applied during the four years of experimentation, the object being to compare the natural resources of the soil with the several separate and variously combined fertilizers consisting of two or three substances, also with lime, plaster and manure.

The results of these experiments, with both corn and wheat, show that these lands require a so-called complete fertilizer.

Plats 29 and 30 show the results of a liberal use of an "unbalanced fertilizer."

To these plats nothing but barn-yard manure has been applied.

The wheat of the last season showed an immense growth of straw, which, however, was soft, falling before the wheat had thoroughly matured, consequently falling below their yields of former years.

This experiment, however, established the importance of incorporating vegetable matter into the soil in order to raise *clover*. Without the application of any seed these two plats have a fine stand of medium red clover, the growth being such that we were obliged to cradle the wheat "high" in order to keep too much green matter out of the sheaves.

Later in the season the "rag-weed" upon these two plats grew as high as the mules' backs.

"Raise clover to improve the soil" should be changed to "Improve the soil to raise clover."

The contrast was so striking that the inquiry, What fertilizer have you used on those plats? was the usual greeting of almost every one who met me when nearby the plats.

It is also true that the plats that have had a double portion of potash have upon them a good stand of clover, the logical deduction being that barn-yard manure and potash are the means by which clover may be grown on these depleted lands.

Neither lime nor plaster (sulphate of lime) alone has produced a good stand of clover even when liberally supplied with a good seeding of clover-seed when seeding to wheat.

FIELD EXPERIMENTS IN WHEAT.

An enlarged number of field experiments in wheat were conducted in the fall of 1904. The first seeding was made October 13th and the last October 19, 1904.

There were ten in all, the manner of fertilization being as follows:

No. 1, a special fertilizer donated by the Virginia-Carolina Chemical Company, applied at the rate of 500 pounds per acre as requested.

No. 2, a special fertilizer donated by A. S. Lee & Son, to be applied at the rate of 500 pounds per acre, one lot being grey in color, the other bluish grey. Analysis: Ammonia, 1 per cent.; phosphoric acid, 11 per cent.; potash, 2 per cent.

No. 3, a fertilizer mixed on the farm. Analysis: 3-8-10, applied at the rate of 400 pounds per acre. The source of nitrogen being cotton-seed meal.

No. 4, a 3-8-10 fertilizer mixed on the farm, the source of nitrogen being nitrate of soda; application, 400 pounds per acre.

No. 5, a 3-8-5 fertilizer, composed of the same substances as No. 4; 400 pounds per acre.

No. 6, "Lee's Agricultural Prepared Lime," drilled with the wheat at the rate of 10 bushels per acre.

No. 7, another grade of lime applied at the rate of 20 bushels per acre.

No. 8, fertilizer, a 3-8-5 preparation, in which 1 1-2 per cent. nitrogen was obtained from dried blood and 1 1-2 per cent. from nitrate of soda.

No. 9, tobacco land fertilizer as No. 8; both Nos. 8 and 9 having 400 pounds per acre applied.

No. 10, treated as No. 9, but rolled after seeding.

These ten plats were all seeded at the rate of 1 1-4 bushels wheat, 2 quarts Fancy Herd grass and 4 quarts timothy per acre.

Plats 6 to 10 had in addition 6 quarts alsike clover seed per acre.

Plats 1 to 6 inclusive were all in the same field, and each one was made up in part of gray soil and red clay, the plats following the contour of the hill-side trenches that had been made to prevent washing.

Owing to this circumstance we had an opportunity of observing the effect of these several fertilizers upon these two distinct characters of soils.

The special fertilizer on plat No. 1 produced the better wheat on the gray soil, more seed appearing to have germinated and the plants tillered (stooled)

better. The same was true of the special fertilizer on Plat No. 2. No perceptible difference could be observed in the manner of growth or yield on the portions fertilized with the gray or with the bluish-gray fertilizer.

Plat No. 3 consisted of 4 1-5 acres fertilized at the rate of 400 pounds per acre as described under field experiments in wheat.

Plat No. 4 fertilized as described.

Plat No. 5 fertilized as described, having but 5 per cent. of potash, occupied the remaining portion of this field.

In the spring these plats were seeded at the rate of 6 quarts medium red clover seed per acre, followed by the spring-tooth harrow having the teeth reversed.

An improvement in the condition of the wheat thus treated was perceptible in a few days, and the best stand of clover is found on the plats thus treated.

By far the best stands are on plats 3 and 4, the fertilizers on these plats containing 10 per cent. potash. Plat No. 5 as heavily fertilized, 400 pounds per acre, as plats 3 and 4 does not show as good a stand of clover as the latter, although the land is very similar in character, the lower percentage of potash evidently being the cause. Plats 6 and 7 upon red clay land, to which "Lee's Agricultural Prepared Lime" and another grade of lime furnished by the same party for comparison were respectively applied. The wheat and clover on plat 6 was better than on plat 7, but on none of the plats from No. 6 to No. 10 inclusive seeded to clover in the fall, when seeding to wheat, is there as good a stand at the present time as on those seeded to clover in the spring, excepting on No. 9, new land cleared for tobacco on which two crops had been grown prior to seeding to wheat.

We attribute the excellent stand of clover on plat No. 9 to the abundance of vegetable matter resulting from the decay of the fibrous roots of the trees and the roots of two crops of tobacco ploughed into the land.

Wherever we succeeded in raising a rich growth of vegetable matter we have good success in raising clover.

No. 10, from the character of the soil, a stiff red clay, was only prepared for seeding after frequently dragging and rolling and after seeding appeared so much rougher than the other plats that we finished it with a corrugated roller. This rolling finely comminuted the particles of soil around the seed so that the wheat came up more uniformly and rapidly than upon any other plat. Unfortunately this corrugated roller cannot be used upon hilly land after seeding, as the grooves in the soil induce washing and the formation of gullies during the times of heavy rain.

The deductions from our experience in wheat culture are: Thoroughly firm the soil, form a fine seed-bed from 2 to 2 1-2 inches deep; where possible roll after seeding; seed to clover in the spring rather than in the fall, following the seeding to clover by slightly harrowing, covering the seed and cultivating the wheat at one and the same time.

EXPERIMENTS WITH TOBACCO.

During the season of 1905 we have continued our experiments with bright, export (shipping) and segar-leaf tobaccos. Of the bright tobacco seven (7) experimental plats were planted, fertilized as follows:

No. 1, with "Formula 44," donated by the Virginia-Carolina Chemical Company.

No. 2, with Orinoco, donated by the F. S. Royster Guano Company.

No. 3, with Hyco, donated by the Columbia Guano Company.

No. 4, with a special fertilizer mixed on the test farm, containing 3 per cent. nitrogen, 8 per cent. phosphoric acid and 10 per cent. potash, the source of nitrogen being cotton-seed meal; of phosphoric acid, the supplement to the cotton-seed meal, being a 16 per cent. available phosphate; and sulphate of potash as the source of potash. This was known as *Special No.* 1.

No. 5, with a fertilizer mixed on the farm, consisting of 3 per cent. nitrogen, 8 per cent. phosphoric acid and 5 per cent. potash, the source of nitrogen being dry blood; phosphoric acid and potash from same sources as *Special No.* 1. This mixture was known as *Special No.* 2.

No. 6, with Peruvian guano, imported and donated by Edw. Mortimer & Co., New York.

EXPORT TOBACCO.

Of export (shipping) tobacco four (4) experimental plats were planted:

No. 1, Pennsylvania seed-leaf, using *Special No.* 1.

No. 2, with *Special No.* 2.

No. 3, with Peruvian guano.

No. 4, with 3 per cent. nitrogen, consisting of 1 1-2 per cent. nitrate of soda and 1 1-2 per cent. dry blood; the sources of phosphoric acid and potash being the same as already reported.

The lands for these ten plats were cultivated to the same extent, the planting being as nearby at the same time as possible, and the subsequent cultivation precisely alike. The bright tobacco was planted upon gray soil recently cleared from which but one crop of tobacco had been taken. The export and Penn. seed-leaf were planted upon a red clay (Cecil?) upon which there had been a heavy growth of medium red clover.

The various fertilizers were applied at the rate of 600 pounds per acre distributed in the rows with a corn planter.

The season was unusually wet, causing "burning" and "specking" of the bright tobacco and more or less specking of the export and seed-leaf tobaccos with comparatively little "burning."

In quality all of our tobaccos are lighter in body, more chaffy and less oily than the crop of last year. In color the export tobacco is as dark as last year, and the bright (flue-cured) compares very favorably with the crops of former years. The Pennsylvania seed-leaf in color would grade from a Colorado to a Colorado-Maduro.

None of the tobacco has been stripped as yet, and the quality must be judged from its appearance in the field and its present condition on the sticks and tier-poles.

Of the bright tobacco the rating is as follows: Best average quality, Plat No. 1, "Formula 44"; second best, Plat No. 6, Peruvian guano; third best, Plat No. 4, Special Fertilizer No. 1.

The differences in the six several plats were very slight, and owing to the unfavorable season it is scarcely just to assert that the same results would occur another season under more favorable circumstances.

The grading that we have given was that given by almost every tobacco grower who visited our plats, they being ignorant of the fertilizers that had been used upon any one of them.

Plat No. 6, to which the Peruvian guano had been applied, "yellowed" sooner and more uniformly than any other plat, but was not in condition to cut earlier than the remaining five plats.

The real value of the several fertilizers can only be established after stripping, grading and sending to market.

The crop of 1904 had not been prepared for market when I was obliged to prepare my report for publication. By reference to BULLETIN No. 3, page 13, it will be observed that our experimental plats were fertilized with a 3-8-10, 3-8-5, and 3-4-5 nitrogen, phosphoric acid and potash fertilizers.

When prepared for market there was but little difference in quality between the first and second kinds of fertilizer, the 10 per cent. potash fertilizers slightly outranking the 5 per cent. potash fertilizers.

The 4 per cent. phosphoric acid fertilizers fell below either of the mixtures in which 8 per cent. of phosphoric acid was used. Reference to the amount of potash taken from the soil with each successive crop, appearing elsewhere, should convince the intelligent reader that most of the fertilizers offered for sale are too low in potash for the best results.

EXPORT TOBACCO.

Of the four (4) experimental plats assigned to export tobacco during the season of 1905, the crops of which are yet on the tier-poles, Plat No. 3, with Peruvian guano, apparently averaged the larger and better quality of leaf.

Of Pennsylvania seed-leaf but one experiment was made. Thus far we have not been able to have a crop fermented. There is no doubt of its growing to good size, color and quality of leaf, but we are not provided with the means of fermenting it and cannot, therefore, report on flavor.

The United States Department of Agriculture has a station in Virginia for experimenting with export tobacco, but the director informs me he has done nothing with segar-leaf tobacco.

Nothing of greater importance connected with the entire tobacco industry could be a subject of investigation than discovering the adaptability of Virginia soils to this class of tobacco. Primarily, the greater number of pounds that can be raised per acre at prices equal to, or greater than, those of export tobacco; secondarily, its sale in a more open market, thus relieving the grower from the domination of tobacco trusts.

TOBACCO SHIFTS.

A comparatively elevated flat, crowning a red clay hill, has reached such a condition that it can be used for a series of years for export tobacco culture.

When seeded to wheat in the fall of 1902 it was heavily seeded to medium red clover in the fall and re-seeded the following spring.

But one crop of clover has been cut each subsequent year, the second crop being allowed to mature its seed, the aftermath remaining each year,

decaying, has formed a mulch, which has improved the soil, which, with the annual, voluntary re-seeding, has fitted it for growing export tobacco.

One-third of this plat was used the past season, a second third will be used next season, and the portion used in 1905 will be seeded to clover in the spring of 1906.

The portion used in 1906 will be seeded in the spring of 1907, the third portion being treated in a similar manner in subsequent years. Thus the tobacco plat will be shifted over the entire flat every three years, and each portion will be in clover two years before being turned under for tobacco.

No better form of vegetable matter can be turned under for the production of *humus*, so valuable in the production of heavy tobacco, than red clover. By a judicious use of suitable fertilizers these shifts can be profitably used for experimental purposes for many years to come.

If the insects affecting the tobacco crop be intelligently fought, they are no more likely to be troublesome than on lands unused for this crop, as I have noticed that they instinctively locate a tobacco field, even if on a new portion of the farm.

EXPERIMENTAL CORN PLATS.

In accordance with the plan to establish a four-year rotation on the 72 experimental plats (36 in each series), but 18 were planted to corn, from No. 1 to 18 inclusive of the second series.

No effort had been made prior to the spring of 1905 to induce the growth of any vegetable matter apart from the crop being cultivated, the object being to learn the effect of the fertilizers alone.

At the final working of the eighteen plats referred to above the ground was heavily seeded to crimson clover, seeding before the cultivator, our effort being to leave the land as level as possible. Eighteen plats of the first series, from No. 1 to 18, were also seeded to crimson clover, preparatory to fitting the land for corn in the spring of 1906. These plats being remote from the other portion of the land under cultivation, are admirably located for *breeding* corn, and seed was selected from typical ears for that purpose.

The land was put into fine tilth and was planted May 8th.

We were obliged to re-plant, owing to the depredations of crows that had assembled in great numbers in the woods surrounding our experimental plats. Although corn soaked in a solution of strychnia was twice liberally strewn on the ground, the effects of which could be seen on dead and dying crows in the woods, but an average of a half stand was left on each plat. As nearly as could be judged by passing through the plats about the same number of stalks remained on each plat. After cutting and shocking the corn an inspection of the number and size of the shocks on each plat corroborated the estimate made during the growing season as to the uniform average of the number of stalks on each plat. Each plat was husked separately and the corn weighed before its removal to prevent the possibility of a mistake in reporting the yield. A good stand, such as found in our *field* experiments, would have given *double* the yield.

By referring to FERTILIZATION OF PLATS, 1-10 ACRE EACH, the fertilizer of each plat from No. 1 to No. 18 can be seen.

The results were as follows:

Plat No. 1, yield per acre, 9 1-7 bushels.
Plat No. 2, yield per acre, 13 6-7 bushels.
Plat No. 3, yield per acre, 20 bushels.
Plat No. 4, yield per acre, 16 2-7 bushels.
Plat No. 5, yield per acre, 12 4-7 bushels.
Plat No. 6, yield per acre, 14 bushels.
Plat No. 7, yield per acre, 17 bushels.
Plat No. 8, yield per acre, 19 4-7 bushels.
Plat No. 9, yield per acre, 21 1-7 bushels.
Plat No. 10, yield per acre, 16 6-7 bushels.
Plat No. 11, yield per acre, 24 2-7 bushels.
Plat No. 12, yield per acre, 9 3-7 bushels.
Plat No. 13, yield per acre, 12 5-7 bushels.
Plat No. 14, yield per acre, 16 bushels.
Plat No. 15, yield per acre, 16 6-7 bushels.
Plat No. 16, yield per acre, 19 3-7 bushels.
Plat No. 17, yield per acre, 18 2-7 bushels.
Plat No. 18, yield per acre, 16 3-7 bushels.

NOTE.—No. 9 of this series had no fertilizer applied, nevertheless it ranked second in yield, being surpassed only by No. 11, upon which phosphate and nitrogen were applied to the land in the form of dissolved bone.

In the selection of ears for seed we chose those of the most uniform diameter throughout the entire length—cylindrical rather than conical, as the former, if a true cylinder, contains three times the volume of the latter; if a true corn of same height and diameter. At least 10 per cent. can be added to the yield of the corn crop, other elements being equal, by applying this geometrical truth.

Ears filled with well-developed tips were chosen, another important element in increasing the yield.

The base of the grains were flat instead of rounded, thus increasing the percentage of kernel to cob.

I regret to report that the cut-worms destroyed the ears to such an extent by eating the soft kernels at the tip of the ear that I could not find a single ear filled out similar to those from which the seed had been selected. The same variety of corn, the ears being of a lower grade, planted in one of our *field* experiments distant from any other corn was but slightly injured by the cut-worms. We propose that our typical ears shall be chosen from this if possible. This unfortunate destruction of typical ears on the experimental plats has thrown us back in the work several years. We had hoped to fix the type in two or three years so that the farm should have corn to distribute to those who felt like assisting in improving our seed-corn.

FIELD EXPERIMENTS.

Our two fields of upland corn were fertilized at the rate of 425 pounds per acre, using a 3-8-5 fertilizer, the nitrogen being in the form of nitrate of soda in one series and dry blood in the other, phosphoric acid from a 16 per cent. available phosphate and the potash from muriate of potash.

In field No. 1 the fertilizer was applied in the row by the corn-planter.

Field No. 2 had five rows unfertilized; to a portion of the field the fertilizer was applied in the row by the corn-planter and the remaining portion was fertilized by means of the grain drill. This method distributed the fertilizer through nearly all the soil, the effect of which was discernible as soon as the feeding roots extended across the rows. A good clover sod had been turned under, yet the effects of the fertilizer was quite perceptible during the entire season, the unfertilized rows being inferior in the size of stalk and ear; the portion fertilized by the corn-planter being much better, and the portion fertilized by the grain drill being so much better that I believe it would pay for the extra labor to distribute the fertilizer by the last named method. When we consider that a portion of the phosphate of lime and potash may not be used by the corn crop, its uniform distribution throughout the entire soil becomes an important factor in soil improvement.

Field No. 1 was seeded to crimson clover just prior to last cultivation.

Field No. 2, owing to the constant wet weather, failed to receive its final cultivation, and, therefore, is devoid of a growing winter crop.

Our lowlands were four times under water from July 1st to July 13th, and the corn on the lowest portions was almost a total failure.

On the more elevated portions we had from one-half to two-thirds of an average crop.

The lands continued so wet in the spring on the lowlands that we did not finish planting before June 16th.

During the four years that corn has been on the lowlands but one good crop was raised. Owing to the frequent overflows of back water from the Staunton river the young corn is often under water in the spring, and the ground remains wet so long that cultivation at the proper time is impossible. These lands could be made profitable pasture or grass lands by being thrown up into twenty or forty-feet beds and seeding to timothy, meadow oat grass and herd's grass. If enclosed by a barb or other wire fence, they would be capable of sustaining from forty to fifty head of cattle during the greater part of the year. The current of the back flow of water would neither injure the wire fence nor wash gullies through the sod.

EXPERIMENTS WITH POTATOES.

Three separate series of experiments were conducted with potatoes. First, for earliness of different varieties; second, for productiveness of different varieties, and third, for productiveness of the same variety treated with different fertilizers, the last group being grown late in the season for keeping over winter.

Earliness.—The same fertilizer was applied to each variety—Peruvian guano at the rate of 600 pounds per acre.

The ground was thoroughly prepared for the different varieties, using the same weight of seed, and were planted April 3d. They matured in the following order, the first named being earliest: Uncle Gideon's Quick Lunch, Vermont Gold Coin, Eureka Extra Early, Noroton Beauty. The stalks of Vermont Gold Coin remained green when the other varieties were entirely dry, although the potatoes were thoroughly matured.

The yield per acre, allowing 60 pounds per bushel, was as follows:
Uncle Gideon's Quick Lunch, 176 bushels.
Vermont Gold Coin, 144 bushels.
Eureka Extra Early, seed from one grower, 192 bushels.
Eureka Extra Early, seed from another grower, 96 bushels.
Noroton Beauty, 160 bushels.

NOTE.—The Eureka Extra Early obtained from different seedsmen appeared to be the same variety of potato, the habit of growth and time of maturity being the same. Whilst all of our seed was free from "scab," the precaution of treating all with formalin was taken as a preventive. In quality the Vermont Gold Coin stands first for mealiness and flavor.

TEST FOR PRODUCTIVENESS.—In this series of experiments, the potatoes being planted eight days later, the potatoes were not disturbed, to learn when each variety was sufficiently mature for market and table use, but were allowed to remain in the ground until the stalks were thoroughly dry. Again the stalks of the Vermont Gold Coin remained green, although the potatoes were thoroughly matured. A severe drought struck them when in full bloom, and no doubt decreased the yield of each variety.

Peruvian guano at the rate of 600 pounds per acre was used for each variety. The yields were as follows:

Wood's Earliest, per acre, 69 1-3 bushels.
Early Sunlight, per acre, 122 2-3 bushels.
Irish Cobler, per acre, 117 1-3 bushels.
Extra Early White Rose, per acre, 86 bushels.
Vermont Gold Coin, per acre, 107 1-3 bushels.

LATE PLANTING WITH DIFFERENT FERTILIZERS.—On a plat of ground seeded to oats and wheat for sheep pasture, and used for that purpose during the spring, we planted the Green Mountain potato for winter use. This variety I have found superior to any other late variety that I have tested during a period of thirty-five years. It is very productive, of fine quality and will not sprout until very late in the season if kept in a cool cellar above the freezing point. My custom has been to air the cellar on clear, cool days when there is no danger of freezing, close the windows at night and if threatened with freezing weather to light a lamp or two. Sufficient heat will be developed to prevent freezing; a small coal oil stove would answer equally well. The ground was plowed, thoroughly harrowed and finished with a Hallock weeder before furrowing. The potatoes were planted deep, covered shallow, and at each successive working a little earth was thrown to the stalks until the ground became level. Just before blossoming the earth was thrown up on either side of the row to prevent the potatoes near the surface from turning green and to keep the tubers cool during the hot days of August and September. The potatoes had a shallow working after each rain to prevent the formation of a crust. By this method crab grass that appears in early-planted potatoes is kept entirely under control.

Rows one and two were fertilized with Peruvian guano at the rate of 600 pounds per acre. Yield at the rate of 127 bushels per acre. All the other fertilizers were a 3-8-5 mixture prepared on the farm.

Row 3, fertilized with Cotton-seed meal, a 16 per cent. phosphate and sulphate of potash. Yield at the rate of 161 2-3 bushels per acre.

Row 4, fertilized with dissolved bone, 16 per cent. phosphate and sulphate of potash. Yield at the rate of 182 2-3 bushels per acre.

Row 5, fertilized with bone meal, 16 per cent. phosphate and sulphate of potash. Yield at the rate of 154 bushels per acre.

Row 6, fertilized with bone meal, basic slag and sulphate of potash. Yield at the rate of 150 2-3 bushels per acre.

Row 7, fertilized with ammonium sulphate, basic slag and potassium sulphate. Yield at the rate of 156 bushels per acre.

Row 8, fertilized with dry blood, basic slag and potassium sulphate. Yield at the rate of 144 1-6 bushels per acre.

The potatoes were weighed as taken from the rows, allowing 60 pounds per bushels. Although the seed had been treated with a solution of formalin some of the potatoes were affected with the scab, a few specimens being the worst I had ever seen.

The season was very favorable for late-planted potatoes. Rain coming at opportune times and towards the end of the season the ground became dry, the potatoes remaining therein until very late with no conditions to develop "rot."

ORCHARD AND SMALL FRUIT CUTLURE.

Our older orchard consists of the following species of fruits: Apples, pears, plums and cherries.

The trees had received very little attention prior to passing into possession of the State Board of Agriculture. It would have been injurious to the trees to have removed all the superfluous wood at a single pruning, and we, therefore, adopted the plan of removing a portion at each pruning.

Trees that did not show a sufficient growth of new wood for the formation of fruit spurs we have pruned during the winter months, and those that produced an ample growth of wood, but did not set sufficient fruit, we pruned during the summer months.

Of apples, the principal varieties are Oldenburg, Shannon, Winesap and York Imperial. Of pears, Keifer, Seckel, Bergamot, Duchess de Angouleme and Bartlett. Of cherries, Richmond, Dyehouse, Yellow Spanish, Napoleon and Governor Wood. Of plums, Abundance, Burbank Wickson, Red June, Ogon and Wild Goose.

The plums were first to bloom. A heavy frost following when the other species were in bloom killed all the cherries, nearly all the apples and about one-half of the pears. The plums were but very slightly injured, the trees setting more fruit than they could bear. Although thinned by shaking and hand-picking, when they had reached full size some of the limbs were broken by high winds. The Abundance proved to be the most profitable variety. The Burbank, although of very large size, proved unprofitable, being subject to rot. The Red June, the earliest of all the varieties, was of very poor quality. The Ogon is the sweetest of all the Japanese varieties in the orchard, but is unattractive in color. The Wild Goose has too little flesh for the size of the pit and is not worthy of commendation. The plum trees have now borne two years and have proven a profitable and reliable fruit.

A young apple orchard upon another portion of the farm has not yet

come into bearing, the trees being headed low and limbs distributed to facilitate spraying when this becomes necessary.

The pear crop was about one-half what the trees could have matured, and were of fine size and shape and very highly colored. Varieties other than the Keifer were badly affected with blight when I took control of the orchard, but by the persistent use of the knife and saw, removing every blighted limb and cutting off all new wood as soon as the disease appeared, the disease has been controlled, but a single blighted limb appearing this season.

Specimens of Sickel pears taken from these renovated trees were pronounced by Colonel Brackett, United States pomologist, "the finest he had ever seen."

A peach orchard, planted a year or two before the farm was chosen as the test farm, had not been properly pruned, the wood being allowed to grow rampant. These required a great deal of work to get them into proper shape. To have removed all the useless wood at one time would have ruined the orchard. The trees were, therefore, subjected to several prunings, removing superfluous limbs, heading in vigorous growth and giving the trees as nearly a vase form as possible under the circumstances. An abundant crop of fruit was set the last season, but the excessive rains and consequent moist atmosphere caused at least one-half of the crop to rot. Spraying was not attemped, as the constant rains would have washed off the fungicide before it could have become effective.

The peach orchard is located on the north side of a steep hill. No doubt this location retarded the bloom and saved the crop from late frosts.

Owing to the almost annual prevalence of late frosts I could not commend this locality for commercial fruit culture, yet every one owning land should set out a sufficient number of trees of the several species of fruit to produce an abundant supply for home use.

STRAWBERRY CULTURE.

The strawberry plat, consisting of upwards of twenty varieties reported in a former bulletin, having exhausted itself, we set out a new plat last spring, selecting varieties covering the entire strawberry season from the standpoints of size, productiveness and quality. They were as follows: Aroma, Challenge Hefflin, Klondike, Lady Thompson and Phenomenal.

Owing to the excessive dry weather immediately following planting although watered daily, we were obliged to replace many of the plants in the fall, adding Boston Prize and Alice Hathaway to the collection.

BUSH FRUITS.

Having after cultivating for three years a plat well adapted to bush fruits, to hold crops for the purpose of exterminating the *wire-grass*, we planted last spring the following varieties donated by the V. P. Institute and James G. Patterson & Son, of Stewartstown, Pa., to-wit:

RASPBERRIES.—Columbia, Conrath, Cumberland, Cuthbert, Erie, Gregg, Golden Queen, Kansas, Miller, Munger, Thompson's Early, Turner, Souhegan.

BLACKBERRIES.—Early Harvest, Erie, Kittatinny, Maxwell's Early, Mercereau, Taylor, Wachusett, Wilson, Jr.

GOOSEBERRIES.—Columbia, Downing, Pearl, Triumph.

CURRANTS.—Cherry, Fay's Prolific, Pomona, Red Dutch, White Grape, Black Champion.

From the above-named varieties we hope to be able to select several from each species that may prove profitable, hardy, productive and of superior quality.

FIG CULTURE.

Of the forty-five varieties of cuttings furnished by the United States Department of Agriculture, rooted under glass in a cold frame, but one variety, namely, Brown Turkey, has survived our winters, the others dy ing down to the ground each year, and consequently setting no *first crop* fruit. Whilst this total loss is to be regretted, the experiment will save others from wasting time and money on varieties not adapted to our climatic conditions—one of the primary objects of a test farm.

COW-PEAS AND SOY BEANS.

Sixty bushels of cow-peas were sowed during the season of 1905 for a three-fold purpose: As a soil improvement, as a source for hay, and to furnish a supply of seed for the following year. The hay was cut from one field and the stubble and roots were turned under preparatory to seeding to winter oats. The hay was cured by joining four pine poles, about 10 feet long at the top, with a piece of flexible wire, the posts being placed in the form of a square measuring 6 feet on either side, a shallow hole having been dug by a post-hole digger to hold the structure more firmly to the ground. At the height of 18 inches from the ground a fence board projecting 18 inches at either end beyond the poles was nailed to the four sides. Boards were laid within the poles on two sides of the structure. On these boards and on the corners projecting beyond the poles the pea-hay was stacked, leaving an open space in the center for ventilation. The stacks were built of a conical form, tapering sufficiently to shed water. About two two-horse loads of pea-hay could be stacked on each frame. One frame was built solid within by laying boards across the fence boards raised outside of the poles. This was done in order to learn if it were possible to stack a greater quantity of hay on each frame. This hay moulded in the center of the stack, showing the importance of air within and without the stack.

Another stack was very much enlarged in diameter on a frame of same size as described above. This also moulded badly, proving the necessity of free admission of air and limitation of size of stack. The remaining twelve stacks kept perfectly. The hay when removed after several weeks of curing being green in color and sweet of smell, the hay being bleached but an inch or two on the outside.

Upon inquiry we have learned that all cow-pea hay in this section that was stacked in solid bulk, either in mow or rick, moulded and became worthless as feed.

The poles and boards when once prepared can be set up in a short time, and if taken down and piled away are ready for use another season.

The attempt to cure it by raking into windrow, heaping afterwards and allowing to cure in the heap for five or six days, is attended with so much risk, owing to wet and cloudy weather, and so much labor, if the heaps must be shaken apart once or more, that the curing on frames is, all things considered, the more practical and economical. We find this method simplier and more reliable than the one we advised several years ago, *i. e.*, a single pole with projecting arms on which to suspend the hay, as the circulation of air is much better and much larger quantities can be placed on the frames.

BACTERIATED SEED.

The seed on a portion of one field were not treated to bacteria culture. Our cultures, excepting for peanuts, were obtained from the Virginia Polytechnic Institute and proved effective. A distinct line, as to prevalence of nodules, ran across the field in which the prepared and unprepared seed was used. Whilst nodules could be found in both sections the untreated seed produced but few plants producing nodules, and these were very small compared with those on the treated seed.

The same results prevailed in our experiments with soy beans, the treated seed producing plants whose roots contained clusters of nodules, whilst those on the plants grown from seed not treated were smaller and less numerous.

In neither the cow-pea or soy bean experiments did we find nodules on every plant grown from treated seed, many plants being as devoid of them as plants found on the untreated plat. We could not discover any difference in vigor, color or fruitfulness between the plants whose roots contained the largest and most numerous nodules, and those on the same plat or the untreated plat on which there were no nodules.

This form of nitrogen must undergo *nitrification* before it become available as plant food, and we have not been convinced, from what we have observed in our various experiments, that it may prove available for a successive crop or add to the improvement of the soil.

The growing of the nodules is a comparatively easy matter, the establishment of their usefulness not so easy.

The culture for peanuts, obtained from the United States Department of Agriculture, showed no apparent results upon the treated and untreated seed, there being about as many plants producing nodules upon the one plat as upon the other.

ALFALFA.

Three cuttings of alfalfa were made as follows: May 22d, July 31st and September 9th. These cuttings averaged about the same as those of 1904, with the promise of another cutting later in the season, but the continuous drought of the fall shortened the growth to such an extent that it was allowed to remain as a cover crop. Nine cuttings in three years have told upon the soil. Not having farm manure with which to top-dress it, the alfalfa shows indications of weakening, crab-grass and broomsedge making their appear-

ance. In all of the experiments with the various grasses and clovers we have been handicapped every year owing to a lack of barnyard manure, not having a sufficient number of cattle to consume the rough food made from year to year.

Nothing so fully improves the physical condition of the soil as manure. In the absence of that we have resorted to cow-peas and vetch to fit these compact soils for the growing of the various crops adapted to this section. Whilst a marked improvement is observable, the result are not such as might have been reached had my urgent request for more live stock each year been heeded. The seeding of about five acres to alfalfa upon land that had been limed for that purpose was without sufficient rain to cause the seed to germinate for upwards of a month. The stand was so thin that the ground was plowed, put in fine tilth and seeded to cow-peas. These were mowed at the proper time. Our pea-hay being made from this plat, the land replowed, fertilized and seeded to winter oats. This was done in order to destroy the weeds. After cutting the oats the land will be thoroughly prepared and seeded to alfalfa. Should the season be favorable a good stand should be expected, and if so, an annual top-dressing of barnyard manure should insure the continuance of this crop through an extended series of years.

VEGETABLE GARDEN.

We have continued our plan of testing new varieties of vegetables generally grown in the farmers' garden, comparing them with the best grown in former years, and if found to be an improvement on the varieties, adding them to our list.

In BULLETIN No. 3, pp. 13 and 14, we gave a list of those that had proven most valuable in our several years' experience on the test farm.

New varieties that we deem worthy of trial are added to the list in italics.

BEANS.—Stringless Green Podded, Wood's Dwarf Lima and Golden Cluster Pole Bean and *Burger's Stringless Green Pod Pole Bean.*

BEETS.—Egyptian, Columbia, Crimson Globe and *Black Red Beet.*

CABBAGE.—Early Flat Dutch, Sure Head, Danish Ball Head and *Perfection Drumhead Savoy.*

CARROTS.—Ox Heart and Danvers.

CAULIFLOWER.—Snowball and Dry Weather.

CELERY.—Golden Self-Blanching and Giant Pascal.

CORN.—Golden Bantam, Country Gentleman, White Evergreen and *Howling Mob.*

CUCUMBER.—White Spine, Cumberland and *Fordhook Famous.*

EGG PLANT.—Black Beauty and *Tree.*

LETTUCE.—Black Seeded Simpson, Hanson, Iceberg, New York, *Immensity* and *Brittle Ice.*

OKRA.—White Velvet.

ONIONS.—Yellow Danvers, Large Yellow Globe, *White* and *Red Multipliers.*

PARSLEY.—Moss Curled.

PEAS.—Prosperity, Nott's Excelsior, Stratagem, *Dwarf Champion*, *Sutton's Excelsior* and *Senator*.

PEPPER.—Chinese Giant and *Neapolitan*.

RADDISH.—French Breakfast, White Chinese and *Red Delicious Radish*.

SQUASH.—Ford Hook and Hubbard.

SALSIFY.—Sandwich Island and Wisconsin.

SPINACH.—Bloomsdale and *Victoria*.

TOMATOES.—Spark's Earliana, Chalk's Early Jewel, Success, Magnificent, Dwarf Stone, *Nott's Early*, *Logan Giant* and *Venable*.

TURNIPS.—White Milan, Golden Ball, Large White and *Norfolk*.

NOTE.—The varieties upon which I had reported in former years still stand in the order of earliness, but some of the additional varieties added this year from a single season's experience will no doubt head the list in earliness.

Howling Mob corn painted as a second early variety was at least one week earlier than Golden Bantam, the earliest true sweet corn that I had previously tested.

Nolte's Early Tomato had ripe tomatoes June 30th, whilst Spark's Earlina had first ripe tomatoes July 4th.

The Neapolitan Pepper was at least two weeks earlier than the Chinese Giant. From the above named list it is possible to select one or more varieties of all the vegetables named that will give a succession from early spring through almost the entire year. In my investigations I have had in view the establishment of farmers' vegetable gardens that should consist of long rows that can be worked with horse and cultivator. An hour spent occasionally in the morning during the growing season with a team will add more to the healthfulness of the family and the happiness of the wife by furnishing her with a daily variety for the table than any other labor of an equal length of time.

MELON CULTURE.

We adopted the same method of protecting the young melon vines from insects as has been described in former bulletins, *i. e.*, they were protected by a covering of plant-bed cloth supported on arched wires placed over each other at right angles. The wires will last for many years and the cloth need be renewed every second or third year.

Replanting owing to insect depredations was unnecessary, whilst our neighbors, who had not adopted this method, were obliged to replant two or three times. Both time and labor are saved by this cloth protection, and, in addition, the plants are uniformly cultivated, with no need of after culture for late grown plants.

In addition to the varieties already tested for quality, productiveness and hardiness several additional varieties were added to the list.

Of watermelons we cultivated the following varieties: Kleckley's Sweet, Halbert Honey, New Monarch, Panura All Heart, Improved Georgia Rattlesnake, Sugar Stick, and Monte Cristo.

As in former years, Kleckley's Sweet led in quality and productiveness. It is the best all-round watermelon for home use and nearby markets thus

far tested on the farm. The very thin rind rendered it unfit for distant transportation.

Sugar Stick produced a few very sweet, early melons, but later in the season was stricken by a disease that turned the rind white, the melon rotting from within.

Monte Cristo did not come up to the high commendation that had been given it.

The other varieties, owing no doubt to the continuous wet weather, produced no melons of a high quality, the Kleckley alone being the variety on which we could depend during the entire season and in all conditions of weather.

We noticed a disposition of this variety to "neck," although our seed was grown by the originator of this melon.

Of cantaloupes the following varieties were tested: Rocky Ford, Burpee's Netted Gem, Wood's Netted Gem, Long Island Beauty, Hollybrook Luscious, Honey, Champion Market, Model and Emerald Gem.

The Rocky Ford, from seed obtained at Rocky Ford, Col., again proved the best in quality, productiveness and uniform size.

The several Gems ranked second, closely followed by the Hollybrook Luscious.

The Honey gave a uniformly sweet melon, but too large in size for hotel or restaurant purposes.

The other varieties could scarcely be classed as *good*, and from their conduct this season should be discarded from future tests. A melon that will develop high quality in cloudy and wet weather should be continued during future years, as under more favorable conditions all its good qualities would reward the grower for his labor.

POULTRY CULTURE.

We have continued the raising of White Plymouth Rocks, believing them to be the best all-round fowl with which we are familiar after having tested upwards of forty (40) varieties. A Cypher Incubator was introduced last season in comparison with natural hatching. Our success with the incubator was entirely satisfactory, a greater percentage of eggs hatching than when placed under broody hens that would occasionally leave the nest before the period of incubation was completed.

The chicks were raised in brooders made on the farm from the model which we had purchased. They were remarkably exempt from diseases of all kinds, very few having symptoms of gapes. By rearing chicks in brooders and changing the location of the same frequently, thus having their run on clean grass, gapes may be kept under complete control. The chicks were confined in the brooders every morning until the dew had disappeared. The brooders were kept scrupulously clean and were frequently aired and exposed to the sunlight. Prepared "chick food," to which a small portion of pure dry blood was added, was fed them frequently each day, care being taken not to feed them more than they would eat up clean on each occasion.

SWEET POTATOES.

Two new varieties were tested last season—Haman, a rich yellow variety of the Yellow Spanish type, and Elzey's Improved Big Stem. The former is of superior quality, but said to be difficult to keep over winter. The latter is a white fleshed variety of fairly good quality, growing too large for market purposes.

Where sweet potatoes are grown for the purpose of feeding hogs, we believe this would prove a profitable variety. We propose to try it for that purpose next season.

ROOT CROPS.

We have continued the growing of Mammoth Long Red Mangel Wurzel and Giant Half Sugar Beet, finding them the most profitable varieties for sheep and cattle during the winter months when succulent food seems to be essential to keeping these animals in good condition, having no silo for that purpose. The land was heavily fertilized with a "complete fertilizer" mixed on the farm high in nitrogen and potash, the important elements of plant food required by this crop. The season was unusually dry at planting and we were obliged to transplant, reducing our area, in order to get a good stand. As in former years, the Long Red Mangel Wurzel produced the heavier crop, but the superior richness of the Giant Half Sugar more than makes up for the deficit of weight.

These have been placed on suitable piles, covered with ground, for winter use. An increased flow of milk is quite apparent when a change is made from the Mangel to the Sugar Beet. The cultivation of this crop is attended with much labor, and we doubt the advisability of cultivating it excepting where a silo is not provided for. We also raised a large crop of White Norfolk turnips, upon which the sheep are turned from time to time. If movable fences were provided, so that they would graze a portion thoroughly before being turned onto another portion, a succulent food could be provided for them at a trifling expense.

These were grown primarily for the purpose of preparing the ground for a crop of potatoes, the turnips, owing to their mass of foliage, thoroughly smothering out all weeds. The seed was sown broadcast, the turnips covering the entire ground, all cultivation having been done before sowing the seed.

COMPOSITION OF VARIOUS CROPS.

The application of fertilizers should be based upon their composition in connection with the available plant food in the soil. Lands long cultivated will become depleted in those forms of plant food existing in the smallest quantity, depending upon the amount required to mature each crop. We find upon inquiry that fertilizers of the same composition are used regardless of the crop grown. From experiments conducted upon this farm for four years we are satisfied that the soils of this section that have been

farmed for many years are as deficient in phosphoric acid and potash as are the soils of the Test Farm.

As a guide to the more intelligent use of commercial fertilizers we give the analysis of average yields of the crops most generally cultivated, stating, however, that physical and chemical causes will, to a certain extent, increase or decrease the soil supply. The following amounts are required for maturing the crops chosen to illustrate this point. Crops far in excess of the quantity here given have been grown, but we have chosen a yield less than which should prove unsatisfactory to every progressive farmer.

KIND OF CROP.	NITROGEN.	PHOSPHORIC ACID.	POTASH.
Barley, 30 bush. per acre	55 1-2 lbs.	17 1-4 lbs.	51 lbs.
Buckwheat, 30 bush. per acre	53 lbs.	21 lbs.	60 lbs.
Oats, 40 bush. per acre	40 lbs.	14 2-3 lbs.	33 1-3 lbs.
Wheat, 20 bush. per acre	41 1-3 lbs.	13 1-3 lbs.	17 1-3 lbs.
Corn ripened, 40 bush. per acre	56 lbs.	21 1-3 lbs.	22 2-3 lbs.
Corn-fodder green, 8 tons			
Potatoes, 200 bush. per acre	36 2-3 lbs.	16 2-3 lbs.	56 2-3 lbs.
Turnips, 350 bush. per acre	40 lbs.	26 lbs.	90 lbs.
Beets, 400 bush. per acre	73 1-3 lbs.	26 2-3 lbs.	126 2-3 lbs
Clover hay, 2 tons	82 lbs.	18 lbs.	88 lbs.
Timothy and Red Top, per acre	46 lbs.	18 lbs.	38 2-3 lbs.
Mixed hay (partly clover)	56 lbs.	14 lbs.	62 lbs.
Beans, 40 bush. per acre	100 lbs.	40 lbs.	70 lbs.
Tobacco, 800 lbs. per acre	39 lbs.	4.3 lbs.	41 lbs.

Note.—This does not include the stalks, which should be returned to the soil.

BETTERMENTS.

There have been added to the farm since coming under the control of the State Board of Agriculture, a fine, well-arranged house, an over-ground ice-house, a granary, a commodious tobacco packing-house, one large barn for curing export tobacco, two fine barns for curing bright tobacco, one barn for air and sun-curing cigar-leaf tobacco, together with placing two pasture fields of about thirty acres each under Page woven wire fence, and fencing three hog-lots with same kind of fence. Innumerable gullies have been filled with cedar and pine brush and covered with ground by means of a road-machine and scraper, enabling us to plow where plowing had not been done for perhaps a half century. One of them, an old mill road at least thirty feet wide and ten feet deep, has been thoroughly filled and can now be easily plowed over. A fine crop of cow-peas has been raised on this "eye-sore," and it is now seeded to winter oats.

The hill-sides have been trenched to prevent washing away the soil, and where manure could be spared from the tobacco land a good sod exists where gulls and gullies formerly abounded. If sufficient live stock had been provided to consume all the roughness grown on the farm in the form of fodder, &c., every hill-side of the farm could have been placed in sod—the only means to prevent washing away the soil.

Much of our time and labor have been devoted to improving the physical condition of the farm, our object being to show how these depleted and gullied fields can be renovated by means existing on the farm. It is now rapidly approaching that condition when experimentation can engage most of the time of the manager and when profitable results can be looked for.

I bespeak the most eminent success for him who will take charge of this line of work in the future.

THE LABOR PROBLEM.

The crying evil of this section is efficient labor. The saw-mills, railroads, &c., have taken the efficient labor of the neighborhood, and only those incapable of doing a day's work, with very few exceptions, can be employed on the farm. The higher wages and fewer hours work per day are the means by which they secure the better help. Much work that should have been done on the farm. was omitted each year through lack of laborers, although the money for securing them was at hand. The only solution to this problem is the one suggested to the Board: Secure a good man with a good wife as housekeeper, erect a house amply large to accommodate all the help and hire young white men who wish to qualify themselves for agriculture and horticulture. Their labor under the care of an efficient manager would prove a "school of practice" that would be most valuable when, in after years, they engage in the most varied of all pursuits.

LIVE-STOCK.

There has been added to the Red Polled cattle a fine male calf, dropped November 16, 1905. Sire, Pride, 8567. Dam. Princess, 6th, 18853.

Lena 3rd, raised on the farm was killed by order of a skilled veterinarian, owing to mortification arising from inability to deliver a dead calf. Every effort was made to relieve the animal, even dissecting the calf for that purpose, but symptoms of blood-poison had developed, and as an act of mercy the heifer was killed.

DORSET AND RAMBOUILLET SHEEP.

Another year's experience with the above-named breeds of sheep prove the value of the cross for early lambs.

The Rambouillet ewes lambed much earlier than the Dorsets, and the lambs (a cross of Dorset buck and Rambouillett ewes) were ready for market long before the pure Dorsets would have been and sold at a price netting 10 cents per pound. We have not as yet sold any pure Dorsets for butchering, retaining them to increase the stock and to sell for breeding purposes.

BERKSHIRES.

Twenty-four pigs have been added to our Berkshires during the year by Beauty, which littered eleven and thirteen in two litters. Thus far we have found a ready sale for all her choice pigs for breeding purposes.

Lady Saxe has proven a failure as a breeder, have had but one litter of four pigs. Whilst a fine sow in size and shape, her progeny have not developed like those of Beauty, and rather than introduce inferior stock we propose to fatten and kill her.

Our experience, whilst limited as to number of breeding animals, has been more encouraging with hogs than with any other form of live-stock, as no other domestic animal can improve the general stock of a neighborhood so rapidly as a fine thoroughbred strain of swine.

S. B. HEIGES, Manager.

SAXE P. O., December 4, 1905.

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